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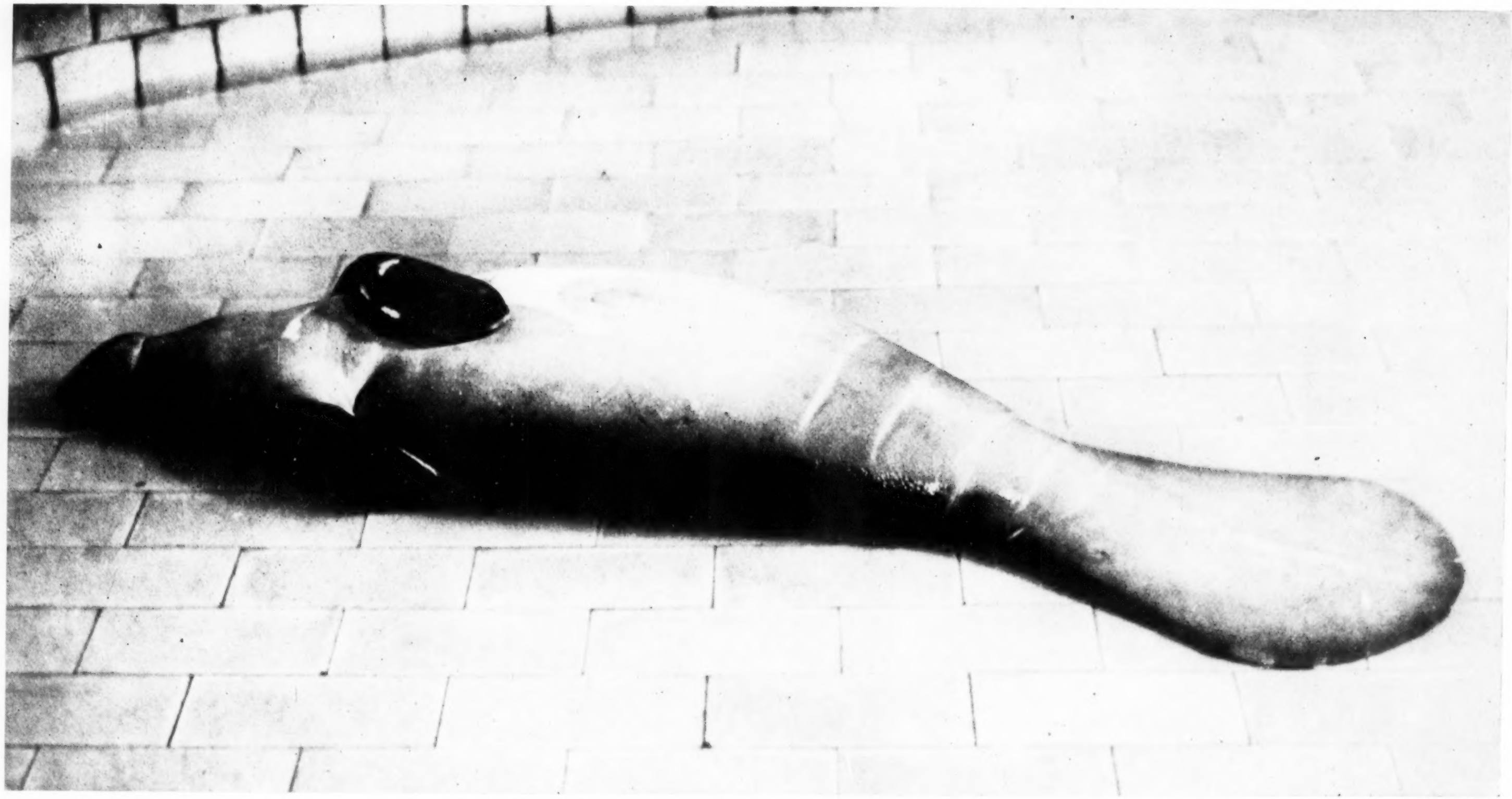


A MANATEE OR SEA-COW FROM THE AMAZON

Manatees of several different species are found in the warmer Atlantic waters of America, sometimes coming as far north as Virginia. The buccaneers of the West Indies and Spanish Main prized them as a source of meat, oil and leather. They are so defenseless that they have been almost exterminated in the waters of the United States, but could probably be increased without difficulty if cared for. The above photograph shows a manatee on its back, a position the animal assumes in order to avoid injury to his flippers, when the water is let out of his tank. Photograph from the New York Zoölogical Society. (Frontispiece.)

A NEW FOOD MAMMAL

Utilization of Florida Manatee Suggested by Alexander Graham Bell—Offers Promise of Easy Domestication, Eats Food that Is not now Used, Would Occupy no Agricultural Land, and Furnishes a Meat That Is Said To Be Delicious

THE shortage of meat and the high price of fodder make the time seem opportune to call attention to a food animal which produces a delicious meat, which recent investigations indicate would be easy of domestication, which lives upon an aquatic forage plant as rich in nutriment as cow pea hay and which has, up to the present time, been so totally neglected as to be threatened by extermination.

Dr. Alexander Graham Bell is originator of the idea, which is first expressed in this article, that we have, so to speak, a new domesticated mammal worthy of serious consideration in connection with the growing shortage in the meat supply of the world and it is to his initiative that is due the preliminary investigation made in Florida this last winter and the search through the literature which has resulted in the present brief article.

Compared with the pigmy hippopotamus[1] as a food animal, the manatee has many points of superiority. It can do no harm, it lives on food plants not now utilized, and it is literally like the fish in our streams at our very door and not in Africa.

Florida has passed a law protecting it; let the State or Federal Government now pass an act to investigate the possibilities in it of a new animal industry for Southern Florida.

The manatee,[2] which has received the popular name of sea-cow, is a docile, easily domesticated mammal resembling a long-bodied seal in appearance. There are no hind limbs, but a broad, rounded tail, which forms a powerful propeller in swimming. The skin is naked like that of an elephant, sparsely covered with hairs and about one inch thick. The animal attains a maximum length of 15 to 18 feet, and old bulls weigh as much as half or three quarters of a ton. The fore limbs are flipper-shaped and anything but graceful, but they are of good size and are used for holding food and conveying it to the mouth. The female carries her young beneath the flipper and suckles it in this position, a circumstance which probably gave rise to the mermaid myth, since the upper portion of the body is out of the water at the time. Columbus states that he saw three mermaids on his first voyage to

[1] The possibility of utilizing the southern swamps for the breeding of this hippopotamus was discussed in the JOURNAL OF HEREDITY, V, pp. 34–37, January, 1914.

[2] The Florida manatee is scientifically known as *Trichechus latirostris*. The appellation "manatee," or as it was originally spelled, "manati," refers to the use of the flippers as hands in conveying food to the mouth and in suckling the young.

Two other species of manatee are known besides that which inhabits Florida; *T. inunguis*, which frequents the Atlantic shore from Mexico as far as the twentieth parallel of latitude south, and *T. senegalensis*, which lives along the shores of Africa and in the Indian Ocean. All three species are so similar that distinct limits to their respective habitats can hardly be marked.

The only other existing family of the Sirenia is the Dugong or Halicore. *D. dugon* inhabits Africa, the Red Sea, Ceylon, India, and the Malay Archipelago, *D. australis* inhabiting the coasts of Australia. The dugong is more distinctly marine than the manatee. The distinguishing mark between the two is the tail. That of the dugong is fluted and shaped like that of a whale, while the manatee possesses a broad, flat tail which is almost circular in form.

The Sirenia form a group apart, and although they have many apparent affinities with other existing animal orders, it has been impossible to establish any certain connection. Some believe that the elephant and manatee are both descended from the same stock: others place the Sirenia midway between the elephants and the porpoises.

AN OLD MAN OF THE SEA

Medieval writers gave the name of *phoca* to various marine animals which in form faintly resembled a human being. Manatees, dugongs, seals, walruses, etc., all seem to have been regarded as one species under this name, and to have been identified loosely with mermaids and tritons. Ambrosinus gives the above picture of what he calls *senex maris*, an old man of the sea. Natives around the Red Sea, it is said, took these creatures to be the survivors of Pharaoh's Army, drowned in the pursuit of the Children of Israel. (Fig. 1.)

the West Indies, but that they were not as charming as he had been led to believe.

MERMAIDS OF THE NEW WORLD

While sailing in the river near the harbor of St. John's, in 1610, Capt. Johann Schmidt relates that he saw a marine creature which resembled greatly a human being with flowing hair and the face of a maiden (Fig. 2) swimming rapidly toward him. This peculiar being did not, however, have the usual timidity of her sex, and seemed to wish to overtake the captain, who fled hastily in order to avoid her. She then made toward the part of the ship where Wilhelm Hacobridge, the captain's servant, was stationed. But the members of the crew also had no desire to make a closer acquaintance with this strange creature, and seizing some sticks, they beat the visitor unmercifully, until she turned and disappeared under the water.

If the author of *Telliamed* is credible, Sirens and Tritons were formerly quite common at Martinique. He cites an affidavit of Pierre Luce, a nobleman, sworn to on May 31, 1761, before Pierre de Béville, a notary, in the presence of Père Julien Simon, Jesuit, and three other witnesses. The statement was sworn to by two Frenchmen and four negroes who, on the twenty-third day of the same month, had gone to the Isles of the Diamond in a boat to fish. When returning near sunset they noticed, near the shore of the small islet on which they were situated, a marine monster having human form from the

A SIREN OF THE AMERICAN COAST

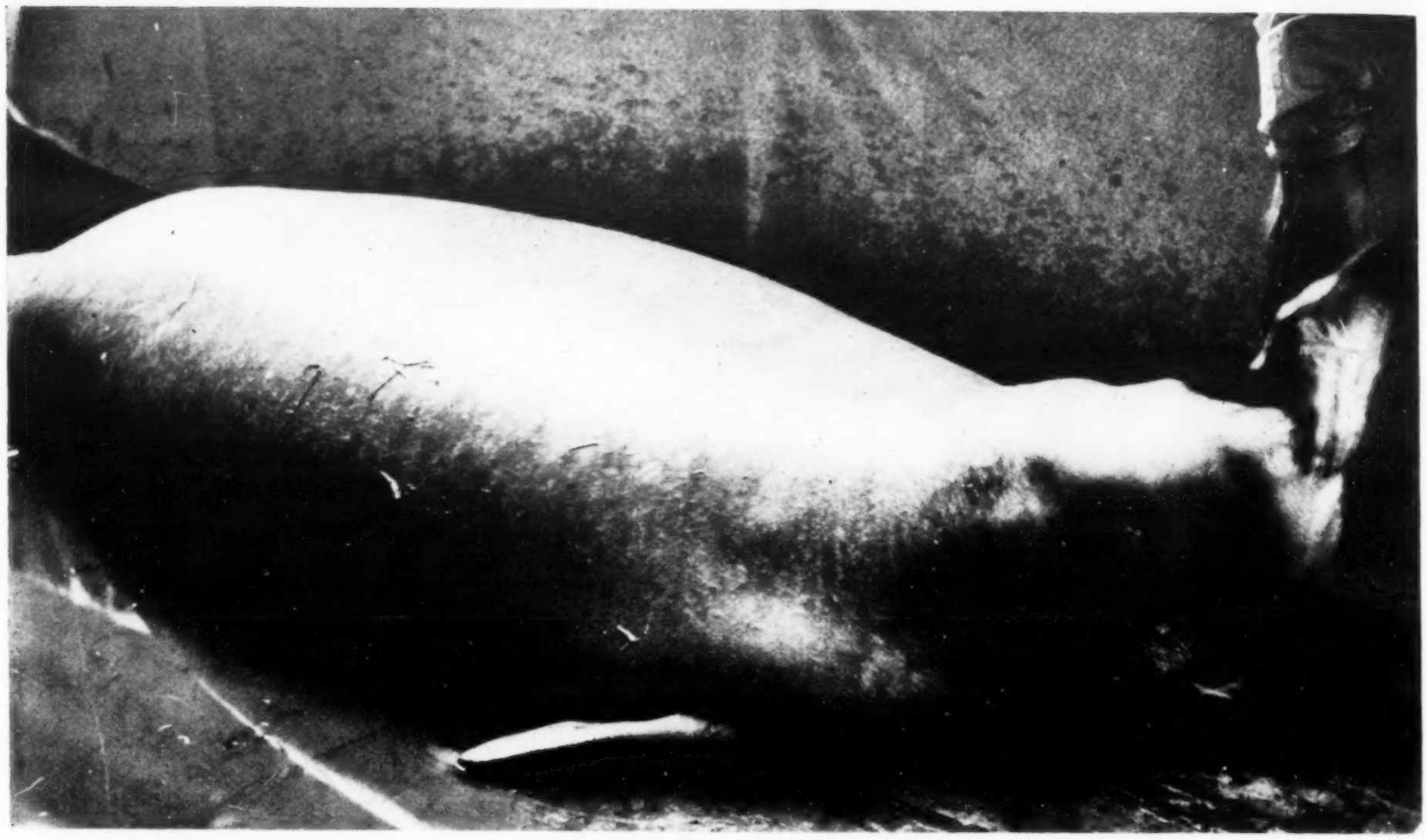
The manatees found in the Atlantic waters of America were taken by early travelers for mermaids and mermen, and some of the descriptions do credit to the imagination of the old voyagers. The above drawing, from an old chronicle, shows the mermaid which appeared to Captain Schmidt and his crew off the coast of Newfoundland, in the year 1610. To the unromantic modern eye, these "mermaids" are far from seductive in appearance (see Fig. 3), but may furnish a valuable meat supply. (Fig. 2.)

waist up and terminating below in the tail of a fish. The head was the size and shape of a man's head, and was covered with black hair, mixed with gray, which hung down over his shoulders. His face was large and round, the nose large and flat, eyes of regular shape, the ears large, a beard of 6 or 8 inches in length and mixed with grey like the hair, while his stomach was also covered with the same kind of hair. His arms and hands were like those of a man, and upon coming out of the water, which he did twice, he appeared to wipe his face. When he raised himself out of the water, the part of his body above the waist appeared to be that of a young man of 15 or 16 years of age, the skin being quite white. The length of the whole body appeared to be about five feet. He regarded the men one after the other for some minutes without appearing surprised. When they first noticed him, he was not more than seven feet from the rock on which they stood, and after submerging, he next appeared about four feet distant, and plunging a third time he came up less than three feet away, so close that one of the men offered him his line to see if he could capture him. The creature then turned and swam away, and again plunging below the surface was lost to sight.

A MONOGAMOUS ANIMAL

To return from mythical to real manatees—they are evidently monogamous in their natural state, but since the dead mate is apparently not mourned by the living animal, it seems likely that one male would be sufficient to take care of a number of females. They breed in small lagoons and bayous and have one or two calves, the period of gestation being probably about eight months. The family commonly consists of four—the adult pair, one half-grown individual and the calf which is generally born in the autumn.

Due to its peculiar anatomy, it is impossible for the manatee to leave the water, and any stories to that effect, if traced down, will be found to be



A FLORIDA MANATEE

Manatees are still found in a few of the inlets and bayous of Florida, and probably could be domesticated in many of the lakes. In captivity they eat almost any vegetable food that is offered, and are extremely docile. The specimen here shown is kept in a tank by Capt. C. H. Thompson of Miami. Photograph by David Fairchild. (Fig. 3.)

connected with some other animal. It is entirely inoffensive and is unable even to resist attack. Its survival in the struggle for existence is due to the fact that it never frequents the open seas, but stays in shallow water, where it is safe from predatory denizens of the deep, and being unable to go on land, it has escaped the pursuit of the land carnivores.

The animals is entirely herbivorous, and what is more strange, does all its eating under water. This is possible because the upper lip is cleft, and the lip pocket, together with the mouth, forms a combination similar to a canal lock system. In captivity, it will eat practically all vegetables and even bread.

Immediately beneath the inch-thick skin is a layer of blubber averaging 1½ inches in thickness. Beneath the latter is the meat, all of which is equally edible. The meat surrounds a skeleton of very simple construction, comprising a skull, vertebral column and strong, massive ribs, of great density.

The manatee has been observed as far north as Virginia, through the West Indies and in Florida, along the Gulf Coast and Mexico, and down the coast as far as the twentieth degree of south latitude. It ascends rivers for great distances. Since Captain Dampier, the explorer, speaks of the animal in the Guatemalan lakes, it is probable that it could exist in domestication in the Florida lakes equally well.

DR. BELL'S STATEMENT

Dr. Alexander Graham Bell writes:

"These huge and inoffensive creatures were fairly swarming in the rivers, bays and lagoons of Florida when the white man first came to America. In countless herds they grazed upon the sea weeds and water plants, just as the buffalo grazed upon the plains of the West. The flesh of the manatee was much prized and the creature was also valuable for its hide and oil. It was not found in the open sea far away from land, but inhabited the shallow waters in bays, lagoons and estuaries of rivers.

"It was an animal of from 9 to 12

GATHERING THE SUBMARINE MANATEE HAY

The principal food of the manatee in Florida is a remarkable grass which deserves attention from agriculturists. It is remarkably rich in nitrogen and contains over 2% of iron. Its long, soft stems nearly fill many of the creeks along the coast, and it can be harvested with a strong rake. Photograph by David Fairchild. (Fig. 4.)

feet in length—about the size of a cow, and was so easily caught that with the increase of the white population it was threatened with extinction. In fact, it has practically, like the buffalo, become extinct, although a protected herd still exists in the Miami River. With suitable protection this herd would again increase and might be made an important food supply for Florida and the world.

"There is no reason to doubt that herds could be easily kept in confinement in the lagoons of Florida, as private property."

An old writer paints this vivid picture of its nature:

"Their manners and dispositions are stated by voyagers to be inoffensive, mild and even amiable. Buffon states that they are both intelligent and sociable, not naturally afraid of man, but rather free to approach him and to follow him with confidence and promptitude. But they have especially a kindly feeling for their fellows. They usually associate in troops and crowd together with the young in the center, as if to preserve them from all harm; and when danger besets them each is willing to bear his share in mutual defense or attack.

"When one has been struck with the harpoon it has been noticed that the others will attempt to tear the dreadful weapon from the wounded flesh.

"When the cubs are captured, the mother becomes careless of her own preservation; and, should the mother be the victim, the young follow her fondly

to the shore, where they are speedily secured and slain."

LONGEVITY OF THE MANATEE

"Buffon also tells us that Gomara reared one in a lake in Santo Domingo, and preserved it for the long period of twenty-six years. It became so tame and familiar as to answer to its name, and took pleasantly whatever nourishment was offered."

The Brighton Museum in England kept a young male in a tank for sixteen months, during which time he throve remarkably and ate lettuce, cabbage, spinach, kale, baked apples, celery tops, etc. By accident, the water was drained out of his tank, and he was left on the bare floor during an exceptionally cold night. He died soon after as the result, but with proper care, there seems to be no reason why he should not have existed indefinitely.

In May, 1907, a bill was passed in the Florida Legislature, placing a fine of $500 on the killing of manatees. The manatees have increased wonderfully since the passing of the bill. Tourists have always had an insane desire to shoot the entirely helpless animals, but with a check of $500 laid on the act, few care to pay the price for the sport.

The dugong, the only family of the order Sirenia besides the manatee, is an animal which is practically identical with the manatee except in a few minor anatomical differences, and inhabits almost the whole tropical region of the Old World. Since the two species are practically identical in appearance, and no sharp line is drawn of the geographical distribution of the two groups, this article will consider them as identical, which they are, considered from an economic viewpoint.

The dugong is considered by the Malays as a royal *fish* and the king is entitled to all that are taken. The flesh is considered by them to be superior to that of the buffalo or ox. The affection of the mother for its young is very strongly marked, and the Malays make frequent allusion to this animal as an example of maternal affection. When they have taken the offspring they feel certain of the mother, and it is said that the young shed tears. These tears are, it is alleged, carefully preserved by the common people as a charm, the possession of which is supposed to secure the affections of those to whom they are attached, in the same manner as they attract the mother to her young.

Unlike many new meats, the flesh of the manatee is universally liked by every one who has tasted it. It is often compared to veal cutlets, although some have likened it to lean pork or tender beef, but all agree in praising its whiteness, delicacy and delicious flavor. When salted, it is like excellent bacon, and keeps well. The tail is often pickled and eaten cold, when it is considered a great delicacy. The buccaneers were accustomed to replenish their supplies by a drive on the manatees, and frequent testimonials in their writings bear witness to the high esteem in which they held the animal.

Dugong skin has long been used in the Red Sea region, and the Children of Israel are said to have covered the roof of their Tabernacle with it. Al-Kazwînî and Ibn-al-Wârdî, medieval Arab men of science, state that in the Sea of Al-Kulzûm (the Red Sea), is a "fish in the form of a cow, which bringeth forth its young and suckleth like a cow," and add, "shields are made of its skin." They later state that in the same sea are "fish shaped like camels, 20 cubits long, the back of which is (like) excellent tortoise shell, and it bringeth forth young and suckleth like human beings." Skin which could be used for covering shields and which was called "excellent tortoise shell" must certainly have been of durable quality. The reference to the camel probably refers to the position sometimes assumed by the dugong in arching its back.

A VALUABLE SKIN

Captain Dampier remarks that the skin of the manatee proved of much value to the buccaneers, who used it for their most strenuous work, including thole straps on their oars. The hides of the old bulls proved too heavy for the primitive methods employed, but

shaved strips were used as horsewhips. When simply dried, the skin was as hard as wood, and dried and twisted strips of the skin afforded serviceable walking-sticks. It is said that native shields which were covered with manatee skin were proof against musket bullets.

The thick layer of blubber which surrounds the entire body furnishes an oil which is also of much value. It is proclaimed as equal therapeutically to cod liver oil, and is, in addition, odorless and practically tasteless and contains no iodine. It is clear, limpid and cleanly, and old writers often remark that it never "rusts" or becomes rancid.

Because of the unusual density, shape and size of the bones, they would make a good substitute for ivory. They take a high polish without cracking, and have no central cavity. Since there are few small bones, the vertebral column and heavy ribs supporting the entire body, practically the entire osseous portion of the body would be available.

With good veal, bacon, ham, beef, chops and other similar meats now retailing at an average of 50 cents a pound, with 85% of the animal available as saleable meat, the economic worth of an animal weighing possibly half a ton and as well constructed for the cutting of saleable meat as is the manatee is easily seen. Although under modern packing house conditions absolutely nothing is wasted, it seems probable that the manatee would be more economically handled in the abattoir than are many other animals now being used.

The natural food of the manatee is commonly known as manatee grass, technically *Cymodocea manatorum*. It grows in the rivers of Florida in enormous quantities, with stems often four feet long, lying dormant in winter, but in summer almost filling the river. It is easily pulled up with a rake with strong teeth, and a man can gather a boatload of it in an hour or two. The following table[3] compares manatee grass with other kinds of hay in common use:

	Manatee grass %	*Alfalfa* %	*Clover* %	*Timothy* %	*Cow pea* %
Moisture...	8.7	8.4	15.3	13.2	10.7
Ash.....	12.9	7.4	6.2	4.4	7.5
Ether extract.....	2.1	2.2	3.3	2.5	2.2
Protein.....	16.6	14.3	12.3	5.9	16.6
Crude fiber.	19.6	25.0	24.8	29.0	20.1
Nitrogen free extract...	40.0	42.7	38.1	45.0	42.2
Iron (Fe_2O_3).	2.46	....	....	....	....

It may be seen by comparing the analyses of the manatee grass and cow pea that the two are almost identical chemically. The manatee grass might be called an aquatic cow pea. Such a promising plant should receive further investigation regarding the cost of cultivation and the area already occupied by it. Dr. Alsberg states that the amount of iron in the manatee grass is remarkable. The plant is so soft and tender that little tufts of it can be easily twisted to pieces with the hands.

In sum, the manatee can probably be reared easily in the warm, shallow waters of the Southern states, which are now unproductive. A manatee will apparently furnish as much meat as a steer, will possibly increase as rapidly, can be easily cared for, and may involve less expense. Manatee breeding as a commercial enterprise in the lakes, inlets and rivers where the climate is warm enough, looks like a feasible, profitable and useful undertaking. Animal breeders should take it up, and should be encouraged by some suitable governmental action.

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[3] The analysis of Cymodocea is that made by the Federal Bureau of Chemistry, through Dr. Carl L. Alsberg, and that of alfalfa from *Farmers' Bulletin* 339, by J. M. Westgate.

MORE POTATOES

Growers Might Double Size of American Crop on Present Acreage by More Scientific Cultivation and by Selecting Entire Hills, instead of Single Tubers, for Planting—United States far Behind European Growers in Potato Production

MORE than five thousand million bushels of potatoes are grown in the world in a normal year. That would allow 5 bushels, or about eight hundred fair-sized tubers, for each man, woman, and child on the face of the globe—not only for the persons who eat potatoes, but for the Eskimo, the Chinese, and the Hottentot, who do not.

No other crop comes within a billion bushels of this total. The potato is, in amount of yield, incomparably the chief food plant of the world.

The Western Hemisphere has little share in this production. South America, the home of the potato, now grows only 7 bushels in every thousand that the world uses, while the United States produces but 6% of the total crop.

As far as the United States is concerned, this low position is mainly due to the inferior methods of planting and cultivating, which are in general use. The Englishman or German grows more than twice as many potatoes on an acre of ground, as does the American—in fact, the average yield in the United States is little more than half a pound per plant, *and a single good tuber weighs more than that.* This shameful showing is partly due to the fact that the climate of the United States is hotter and drier than might be desired for potato-growing; it is partly due to the fact that European potatoes are often of a coarse but heavy-yielding variety, suitable only for stock food or starch and alcohol manufacture; it is partly due to the fact that Americans do not fertilize their land to the best advantage; but it is to a considerable degree due to the failure of Americans to use the most intelligent methods of selection of tubers they plant.

While a single hill, in the United States, yields on the average only half a pound of potatoes, a single hill in English experiments has produced 20 pounds. This shows that there is a variability which offers abundant chance for permanent improvement; and plenty of cases can be cited which prove that such improvement can be made. Spillman, for example, mentions a Michigan grower who "some years ago began the practice of digging by hand enough potatoes for seed, and saving only those hills that had six or more merchantable tubers and no small tubers. When he first began this practice, only sixteen hills out of each hundred dug came up to this standard, but after he had continued the practice for five years the number of such hills had risen to seventy in a hundred."

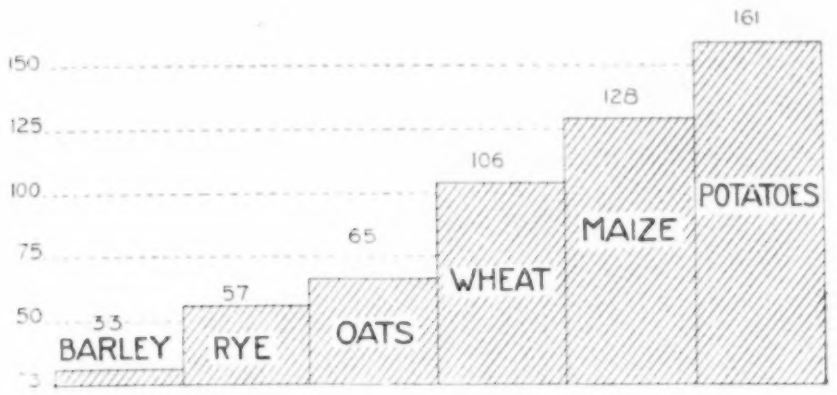
IMPROVEMENT IS IMPORTANT

The improvement of the American potato yield is thus entirely feasible, if a little thought is used. How great a change in the total would be caused by a very slight increase in the hill yield, is pointed out by Luther Burbank, who calculates that to add only one tuber to each hill would augment the annual crop by 21,000,000 bushels. If the half-pound average yield of American plants were doubled—an achievement that ought to be easily possible—the 3,500,000 acres planted to the crop in this country would produce enough potatoes so that every individual in the country could have 5½ bushels a year:[1] enough potatoes to insure an

[1] Surveys of many farm communities in the United States have shown that the consumption of Irish potatoes is often 5 bushels per person per year, or about 25 bushels per family. In potato-growing regions, it may be double this. It is evident that in large parts of the South, and among many elements of city populations, the consumption of potatoes must be small.

abundant and cheap supply for domestic use and a large exportable surplus.

With potatoes selling at $3 or $4 a bushel this spring, every householder has been obliged to realize that something is wrong with the American potato supply. The trouble lies partly in bad



FOOD CROPS OF THE WORLD

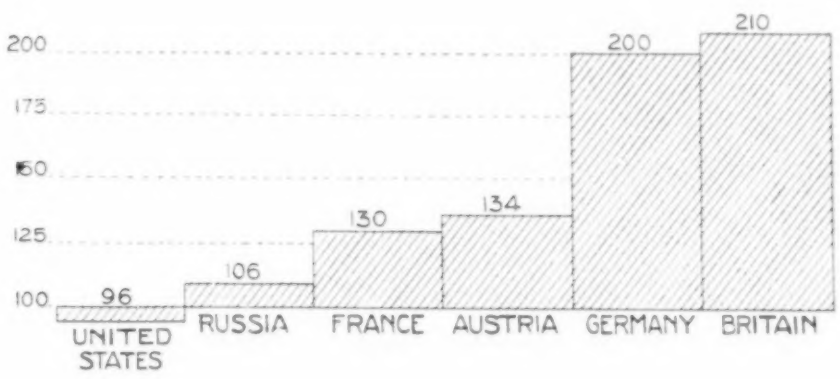
The figures show the annual yield in millions of tons, average for five years, 1908–1912. Rice is omitted, because the figures from large parts of China, where rice is extensively grown, cannot be obtained. Probably rice belongs between oats and wheat in the above diagram. Data after Gilbert. (Fig. 5.)

weather and plant-disease, but it is to some extent due to failure to apply knowledge that is the common property of every plant-breeder. A. W. Gilbert's book on "The Potato,"[2] is, therefore, timely, for Dr. Gilbert was long professor of plant-breeding at Cornell University and chairman of the plant-breeding section of the American Genetic Association, and naturally devotes particular attention to the problems which fall in the field of genetics.

"The principal method of improving the potato is by bud-selection," Dr. Gilbert says. "Potato hills are very variable, and improvement is made by planting the tubers from the best hills. Many of these apparent improvements may be due to some advantage in growth, such as increased fertility, more light or moisture, and so forth. Of course, this increase is only transitory, and not being inherited, produces no permanent advancement.

"The potato, however, presents variations which are inherited. These are of two kinds—smaller differences whose inheritance produces a gradual change, and large differences or so-called 'bud sports' or bud-mutants which immediately become the starting point of new varieties.

"Potatoes differ from most farm crops in their manner of reproduction. They are propagated vegetatively without the intervention of a sexual process like corn or wheat. Each hill of potatoes comes from one tuber or part of a tuber which was the product of one bud of the mother plant. Hence the entire hill becomes a unit, and hill selection is, in reality, bud selection. Single tubers cannot be said to be units from the breeder's standpoint. Therefore, it is of supreme importance to take into account the yield of an entire hill and



BUSHELS OF POTATOES PER ACRE

Germany and Great Britain get more than 200 bushels of potatoes from an acre of land. The United States does not do half as well as this, but might easily improve its showing. The figures show the average annual yields per acre for the years 1904–1914, after Gilbert. (Fig. 6.)

not the presence in it of two or three large tubers resulting in low total yield for the hill."

MASS SELECTION

"Until recently, the method of selection has been to choose from the potato

[2] The Potato, by Arthur W. Gilbert, Ph.D., formerly professor of plant-breeding, New York State College of Agriculture at Cornell University, assisted by Mortier F. Barrus, Ph.D., professor of plant pathology, New York State College of Agriculture, and Daniel Dean, formerly president of the New York State Potato Association. The Rural Science Series (edited by L. H. Bailey). Pp. 318, price $1.50 net. New York, the Macmillan Co., 66 Fifth Avenue, 1917.

bins in the spring the requisite amount of seed, using tubers having the desired shape and size but without knowledge of whether they came from high yielding strains or not. This method of choosing seed from year to year, using merely the best tubers without a knowledge of their ancestry or obtaining a test of their producing power, is known as 'mass-selection.' This method will inevitably lead to improvement because the very poor hills will not produce good tubers, and hence will be eliminated. But the improvement is a very slow one. In employing this method of mass selection, growers were working blindly without knowing how or when or even whether they were going to reach a stability of type."

Intelligent breeders have now discarded this method of picking the best tubers out of the bin without knowing anything about their past. In its place they use the method of pedigree-breeding, picking out the best hills for perpetuation, instead of the best single potatoes. The grower should have a vivid mental picture of the standard toward which he is working, and then should choose his seed-potatoes from those hills which, as a whole, most nearly meet his ideal.

Ideals for the perfect potatoes naturally vary with localities, but certain attributes are universally desired. Among these are:

1. High yield. This means not only a large number of potatoes per hill, but a large number of large potatoes, few or no small ones.
2. Good quality. For culinary use, this means a large amount of starch, which makes the potato mealy when cooked.
3. Disease-resistance. Particularly in the Eastern United States, diseases are a serious hindrance to potato growing. There are no varieties that are disease-proof, but some are much more resistant than others.
4. Good keeping qualities. Potatoes must often be stored for a long time before they are used.
5. Good color of flesh and skin. In general, a yellow skin and white flesh are desired, but the South prefers a pink-skinned variety.
6. Skin of good texture. Buyers seem to think that a netted and slightly rough skin is to be preferred as indicating proper maturity and good quality.
7. Tubers of good shape. Flat-round or flat-oval potatoes are preferred to oval or cylindrical.
8. Shallow eyes, relatively few in number. This saves waste in peeling and lessens decay.
9. Proper length of season. Some varieties mature in seventy days after planting, others require 200. The grower must have a variety suited to the length of his local season.
10. Upright, vigorous plants. In general, a wide-spreading plant takes up more room and is more expensive to spray.
11. Thick-skinned leaves. These are not so easily penetrated by disease-spores.
12. No tendency to "second growth."
13. Trueness to type of variety grown.

With a definite knowledge of the kind of potato he wants, the grower will dig enough hills by hand to find some of his best, that conform to his ideal, and he will save the potatoes from these hills for his next planting. If he is going at it scientifically, and plants on a large scale, it will pay him to grow this seed for a few years and select the best each year for planting.[3] But most farmers will probably content themselves with picking out good hills for next year's crop. These may be chosen either by weighing the total number of potatoes produced, or by counting. If the season has been an average one, hills which contain six or more good tubers are saved for planting. In a poor year it may be necessary to use hills which contain only five; in a good year the standard may be raised to seven. There is no attempt at pedigree breeding by keeping the different strains separate. All hills meeting the established standard are thrown together and saved for seed. The next year these are planted; in the fall the process of selecting the best hills is repeated. This method will gradually eliminate the poor strains and raise the average yield of the crop very rapidly. The first year, perhaps only 5 or 10% of the hills will be found to have produced as many as six good tubers; the second year this percentage should be more than doubled; while after three years of selection, six marketable potatoes should be found in a fourth or a third of all the hills in the field.

[3] Full details of a method worked out by Dr. H. J. Webber, secretary of the Research Committee on plant breeding of the American Genetic Association, are given by Dr. Gilbert (pp. 63–69). This method is said to have been remarkably successful.

Zavitz, of the Ontario Experiment Station, selected the best hills of seven varieties of potatoes for a period of sixteen years. During the first four-year period their average yield was 120 bushels. During the three succeeding periods of four years each, as a result of selection, the average yields were increased to 216, 218 and 249 bushels. Within the sixteen-year period, the methods of culture were kept practically the same and the result is, therefore, to be attributed to selection.

But when single high-producing hills are saved for the next year's planting, one should make sure that they did not come from some highly fertilized or particularly favorable part of the field. Preferably they should be chosen from the poorer parts where their production has been high in spite of a bad environment. This will show that they really have good heredity: and it is potatoes of good heredity that must be depended on to put money in the grower's pocket.

For further details, the grower must consult Dr. Gilbert's book. It is difficult to think of any subject connected with potato-growing, which he has not covered. History, botany, climate and soils, fertilizers, planting and cultivation, insects and diseases, harvesting, marketing, and by-products, are all discussed, and the last chapter considers the important matter of profits. A review of genetic experiments on the potato brings together many results in a convenient form.

HISTORY OF THE POTATO

Considering how recently the potato was brought to the attention of the civilized world, it is remarkable that it should now be the greatest food crop, supplying about one-fourth of the entire diet of European countries. It was first discovered by the Spaniards in the neighborhood of Quito, Ecuador, where it was cultivated by the natives. The first notice is that of Pedro de León (1550) who mentions that the inhabitants of Peru lived largely on maize and "papas," the latter the Indian name of the potato which is still universally used in Latin America. The natives often dried their potatoes in the sun and made them into flour—a practice followed in Europe but little known in North America, although it should be widely used.

The vegetable may have been carried to Spain as early as 1535; thence it spread all over Europe, but only as a botanical curiosity. The Spaniards brought it from South to North America some time before 1585, since friends of Sir Walter Raleigh secured it in Virginia in 1586 and brought it to England. At the discovery of America, von Humboldt says, the plant was cultivated in parts of western South America from Chile to Colombia, but not in Mexico, and there is no record of its being found wild in North America. Many forms are found growing wild today in South America, but it is impossible to say that any of them is an originally wild form. The potato has, perhaps, been so long under cultivation that the wild prototype has ceased to exist.

Europeans long looked on the potato with disfavor, and its culinary use spread only as an emergency food in time of famine, although it had become quite widely used as a food for animals particularly in Germany. It is only in the last century it has become a staple on the dinner table. The number of varieties has become very large, but there are scarcely more than a half dozen types in the United States which possess real commercial importance. Experimenters will from time to time be able, perhaps, to produce something better than is now grown. But the task of the farmer is merely to pick out the best strains from the present varieties. This task he can easily achieve by selecting only the best hills for planting; and a little care in this selection, even if no new acreage is planted, ought eventually to double the value of a crop which is already worth half a billion dollars a year to the United States.

THE GLUTEN OF BREAD

Protoplasm the Physical Basis of Life—Distributed in Form of a Network Can Be Visualized by Study of Gluten in a Grain of Wheat

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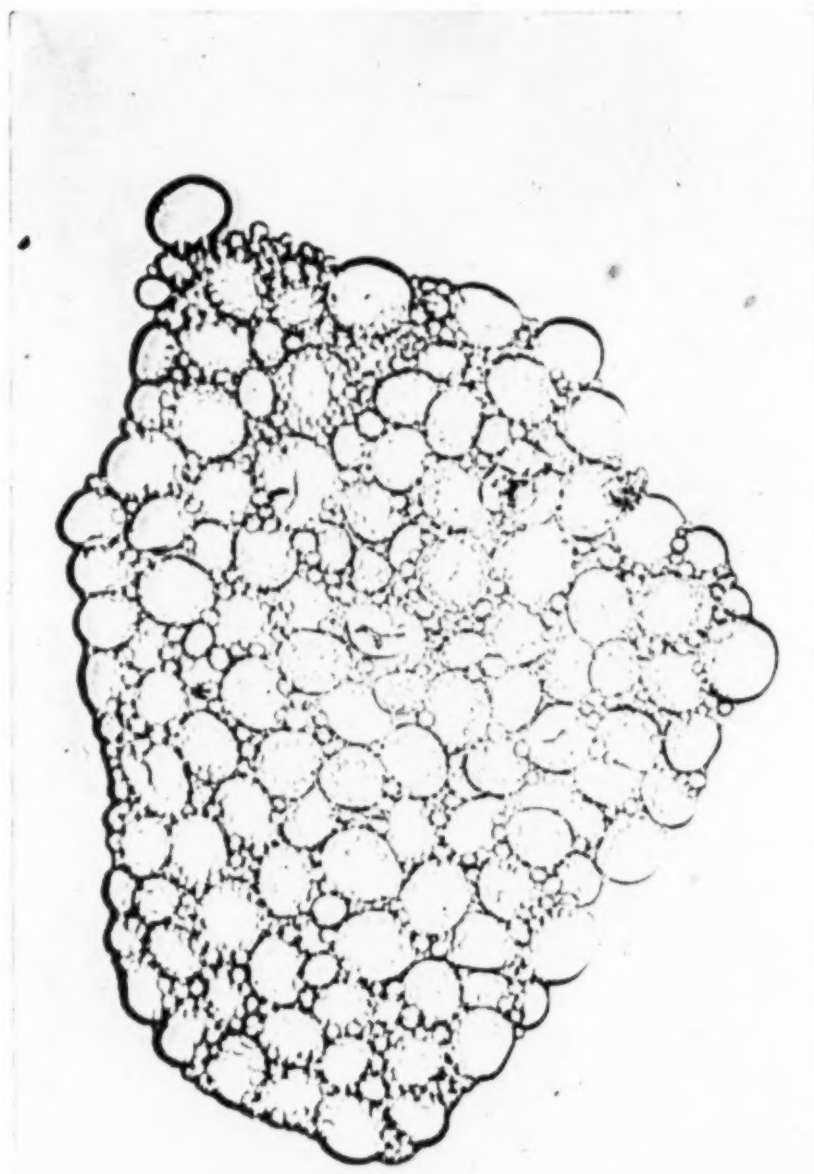
PROTOPLASM is much talked about and called the physical basis of life, but when the layman speaks of it, he often has no definite picture in his mind. He knows that it is said to be like an emulsion, that it contains carbon, hydrogen, oxygen, nitrogen, sulphur, and various salts, that it is so complex as to baffle any exhaustive analysis; and he thinks of it as a mysterious substance known to men of science, but quite outside his own world of experience.

This is not wholly correct. Most people, at least if they live in the country, have at some time chewed a few grains of wheat, spitting out the bran and swallowing the dissolved starch, until finally there was left on the tongue a little pellet of tough, elastic gluten. This gluten is one form of protoplasm.

Every living cell must contain protoplasm—otherwise there can be no life in it—and this protoplasm is arranged in the form of a network, as can be conveniently seen by study of a grain of wheat. The wheat kernel is not a single cell: it consists of the germ, or embryonic plant, and ten or twenty thousand minute flour-cells whose function is to supply nourishment to the embryo while it is sprouting. Flourcells and embryo are all enclosed in a fibrous protective covering, which, when removed by the miller, is bran.

By careful handling, a single one of these flour-cells can be taken out and placed under the microscope. At first sight it appears to consist merely of starch granules. The starch is soluble in water, and can be washed out by boiling. It then appears that the cell has a complicated structure; that it consists of a network of tough gluten, in the interstices of which the granules of starch were lodged. This structure is beautifully illustrated in a drawing from a preparation made by N. A. Cobb (Fig. 8.)

"Every flour-cell has all the common constituents of the living cell, and all are in a living state—each in its proper position, and reacting as living matter.



A FLOUR-CELL

A grain of wheat consists of the germ or embryonic plant and ten or twenty thousand flour-cells like the above, which are intended to supply nourishment to the embryo as it grows. The flour-cell appears at first to be merely a mass of starch granules of different sizes, but when these are washed out, a definite structure is revealed. Photomicrograph by Albert Mann, about 200 times actual size. (Fig. 7.)

There is the protoplasm with all its complexities, the nucleus with all its directive possibilities; there is the starch and the soluble portion together with

NETWORK OF PROTOPLASM IN A FLOUR-CELL

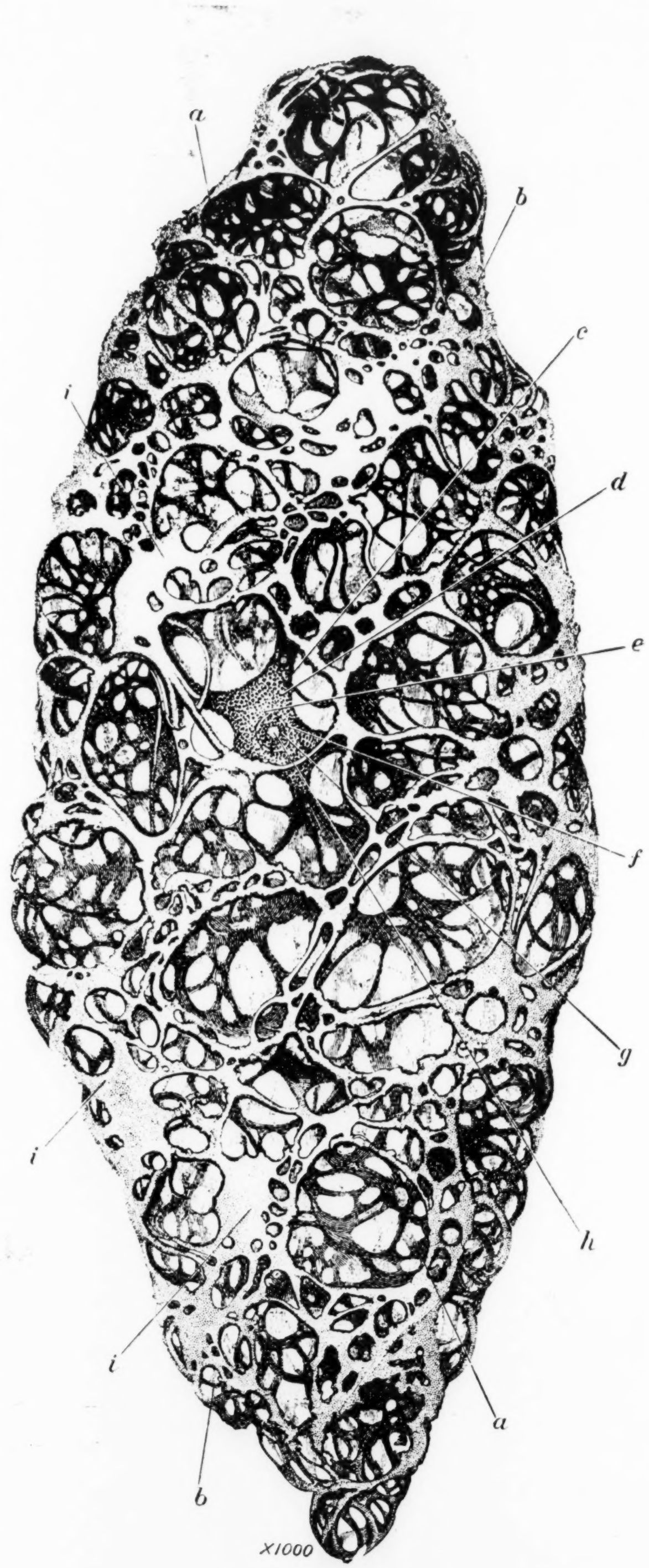
In a grain of wheat there are ten or twenty thousand flour-cells like the one shown herewith—magnified to 1,000 diameters. The wall of the cell has been removed and the starch washed out so that the complex and definite structure of the cell is revealed. Like all living cells, it consists of a network of protoplasm, that substance without which life cannot exist. In wheat, the protoplasmic network and the nucleus constitute the gluten. The details are as follows: *a*, *b*, the network in whose meshes large and small starch granules were held; *c*, the wall of the nucleus; *d*, the chromatin of the nucleus; *e*, a more or less colorless zone surrounding the true nucleus; *f*, wall of the nucleus; *g*, granular components of the nucleolus; *h*, vacuole of the nucleolus. The nucleus is very irregular in shape because of the pressure on it of the starch granules.

As protoplasm is a very complex substance, it would be a mistake to suppose that all protoplasm is comparable with the gluten in wheat. As a fact, the protoplasm of every species is different, and there are only a few grains in which the proteins are found in tough masses, as in the gluten of wheat.

Within a single species, the proteins have many different forms. The protoplasm in the wheat germ is not exactly the same as that in the starch cells. Indeed, so complicated is the subject that the grain of wheat has been very figuratively likened to a chemical laboratory, in various parts of which various compounds are being constantly made.

It seems probable that the gluten, like the starch, is used as nourishment by the germ of the wheat, when it starts to grow.

With the discovery that each species has its own characteristic protoplasm, it was also learned that the different proteins produce different effects in the nutrition of men. This greatly complicated the question of a suitable diet. It is not desirable to depend on the protoplasm of any one plant or animal species for human food, but to eat a wide range of proteins. This will insure that the body gets the compounds which are necessary to it. (Fig. 8.)



A SLICE OF WHITE BREAD

Magnified ten times to show how it is made up of bubbles of the sticky gluten intermingled with the cooked starch to form a sponge-like mass. The dark places in the photograph are air-spaces. One of the principal offices of the gluten is to hold the carbon dioxide gas which is formed in baking by the action of yeast and steam. It is this gas which makes the bread "rise." White flour such as is used in this bread is mostly starch and contains only 7 or 8% of gluten, the most valuable parts of wheat for the purpose of building the human body. Photograph by John Howard Paine. (Fig. 9.)

BREAD MADE OF WHOLE WHEAT

Ordinarily, the innermost layers of bran and the layers of starch cells adhering to them are removed together and, as "shorts," "middlings," etc., used as food for live-stock. Their rich content of protoplasm makes them a valuable food. Sometimes they are used for human food, when the entire wheat kernel is ground into flour. A slice of this whole wheat bread, ten times actual size, is shown above. It may contain twice as much protoplasm as does ordinary white bread. Photograph by John Howard Paine. (Fig. 10.)

a limited amount of water. We are accustomed to speak of the wheat seed as having a suspended vitality, but this is only a rough approximation to the truth. The fact is that its cells are living and have indeed accomplished only one-half of their allotted life. The other half is connected with the transference of their material to the embryo as needed. The seed, therefore, has its living activities, and, though these are not as rapid as those of the ordinary plant cell, it is impossible to point out any other essential difference. Their rate of life is retarded, not suspended, as we ordinarily say, for if the seed be kept dry it goes on living for a number of years, according to the kind of seed, and then dies."[1]

From this it is evident that flour, as it comes from the mill, is also alive. Most of the flour-cells will have been crushed, but some of them will pass through the rollers unbroken, thanks to their small size. Whether whole or crushed, they are alive. Wheat flour is living matter, just as much as is a raw egg or oyster, for some time after it is made, until it has ripened, as the millers say, or died, as a biologist would put it.[2]

Different wheats contain different amounts of protoplasm. The durum wheats, of which macaroni is made, are notably rich in this respect—so much so that they do not bake up well into bread, unless given special treatment.

It has been found that the flour-cells in the interior of the seed contain the smallest amount of protein or gluten (about 7%), while the amount increases in cells nearer the surface, until those just under the bran contain as much as 16 or 17%. Unfortunately, when ordinary white flour is milled, the richest gluten cells are thrown out with the bran and what is in many ways the most valuable part of the grain is thus eliminated. Hence the great superiority, as a body-building food for man, of war bread or any whole-wheat bread in which much if not all of the bran is included.

The Classical Example of Consanguineous Marriage

The Ptolemies, who ruled Egypt for several centuries, wanted to keep the throne in the family, and hence practiced a system of intermating which has long been the classical evidence that consanguineous marriage is not necessarily followed by immediate evil effects. The following fragment of the genealogy of Cleopatra VII (mistress of Julius Caesar and Marc Antony), is condensed from Weigall's Life and Times of Cleopatra (1914), and shows an amount of continued inbreeding that has never been surpassed in recorded history, and yet did not seem to produce any striking evil results. The ruler's consort is named, only when the two were related. The consanguineous marriages shown in this line of descent are by no means the only ones of the kind that took place in the family, many like them being found in collateral lines.

Ptolemy I
|
Ptolemy II
|
Ptolemy III m. Bernice II, his half-cousin.
|
Ptolemy IV m. Arsinoe III, his full sister.
|
Ptolemy V
|
Ptolemy VII m. Cleopatra II, his full sister.
|
Cleopatra III m. Ptolemy IX (bro. of VII), her uncle.
|
Ptolemy X m. Cleopatra IV, his full sister.
|
Bernice II m. Ptolemy XI (bro. of X), her uncle.
|
Ptolemy XII, d. without issue, succeeded by his uncle,
Ptolemy XIII
|
Cleopatra VII

[1] From an address by Dr. Cobb at the Bakers' Institute, Milwaukee, 1908; printed in thirteenth biennial report of the Bureau of Labor and Industrial Statistics, Pt. v, Madison, Wis., 1908, pp. 735–747.

[2] Under favorable atmospheric conditions, it may live for six months or more. Formerly the millers hastened its death by controlling the temperature and moisture; now they electrocute it, thus "ripening" it without delay.

DEATH OF PHILIPPE DE VILMORIN

PHILIPPE LEVÊQUE DE VILMORIN, one of the most conspicuous figures in European genetics, died on June 30 at the age of forty-five, according to a cablegram received by President David Fairchild of the American Genetic Association. A reserve officer in the French Army, he was for a time attached to the Anglo-Indian Army in France as an interpreter, and later was a French Purchasing Agent in London. He had been ill in Southern France for some months, presumably as the result of overwork.

Although identified with plant-breeding, M. de Vilmorin also carried on dog-breeding experiments for many years. His closest scientific affiliations were with William Bateson of England, whom he regarded as his Mentor, and J. P. Lotsy, the Dutch botanist. He was secretary of the last International Conference on Genetics, and a life member of the American Genetic Association. He had made numerous trips to America, had many friends here, and published a report for the French Government on agriculture at the St. Louis Exposition. His published work is considerable in size and value, but his greatest contribution to genetics was, perhaps, his personal influence, which can only be understood by the help of a knowledge of his family history.

As early as 1727 there was in Paris a seed store "*Au coque de la bonne foy*," kept by Pierre Geoffroy, whose daughter and heiress married Pierre d'Andrieux, a botanist. Their daughter in turn married, in 1774, Philippe-Victoire Levêque de Vilmorin, a young botanist belonging to a Lorraine family which was identified with war and agriculture. Thus was founded the business still known as Vilmorin-Andrieux and Company, one of the most celebrated seed-growing and seed-selling establishments in the world.

PRODUCTION OF THE SUGAR-BEET

The business was handed on from father to son, and the family grew in size and importance as did the business, the two being identified in a remarkable way. Many de Vilmorins have, in every generation, been identified with the progress of scientific agriculture in France, but none is so well known as Louis de Vilmorin (1816–1860), the producer of the sugar-beet. Of the three great contributors to the theory of genetics, in nineteenth-century France, de Vilmorin alone did work of great practical importance. Jourdan's study of the nature of species and Naudin's hybridization experiments which so nearly revealed the laws of Mendel, have had great influence; but de Vilmorin, the third of the trio, not only invented the centgener method of breeding, but revolutionized the sugar industry. His achievement is one of the stock examples in text-books of plant-breeding. Starting with a sweet yellow beet from Germany, he analyzed many roots, selected those which had the highest sugar content (from 10% to 12%), and planted separately the seeds borne on each root. From the rows which produced the best yield, he again selected the roots with highest sugar content, and so continued until he had raised the average yield to about 18%, a figure which has hardly been surpassed since his time. By growing this strain of beets, continental Europe was able to make sugar in competition with the cane-growing countries of the tropics.

Louis de Vilmorin was succeeded as head of the family and of the business by his son Henri, who made many contributions to the study of heredity, his work on wheat and potatoes being best known. He died in 1899, when Philippe de Vilmorin, whose death has just been announced, succeeded him. By this time the large family had become one of the most important in France, scientifically, financially, and socially, and Philippe's position as head of it carried a prestige which can hardly be understood in the United States. The business had also reached

large proportions, seeds being grown in many parts of the world. A great farm at Verrières-le-Buisson, near Paris, has been used since 1815 for seed-testing experiments, and much experimental breeding has been done here in recent years by Hagedoorn, Meunissier, Mottet, and other geneticists in the employ of the firm. Adjoining it is the estate where Philippe spent most of his time engaged in his own genetic experiments, the active direction of the business having been taken over by his brother-in-law, Comte d'Etienne.

Another very important figure in French agriculture is his uncle Maurice, who, at Les Barres, has one of the greatest collections of shrubs and trees in Europe, and who has long been president of the Academie d'Agriculture. He published a book on "Horticulture in the United States" in 1894, and the monumental "Fruticetum Vilmorinianum," in 1905.

A letter written to President Fairchild by Maurice de Vilmorin on June 17 reveals how the trained horticulturists of France have been drafted into military service to such an extent as to endanger the existence of the remarkable collections created at great expense by the Vilmorins and others.

"In fact," M. de Vilmorin says, "I am so destitute of workmen that I scarcely am in a position to maintain the plants of my numerous collections. I can do nothing more until the circumstances are fortunately changed for a better standing."

Henri, a younger brother of Philippe, has made several visits to the United States, the last just prior to the war, and has many friends here.

THE VILMORINS IN THE WAR

The de Vilmorin family has lived up to its military traditions in the war, Henri being an officer in the navy and the other four brothers having commissions in the army. Philippe's work as interpreter has been mentioned. Vincent returned from China to join his company and is understood now to be with the French expedition at Salonika. Louis has commanded a section of automobile guns and won two medals and mention in dispatches for his gallant conduct. Jean was hit by four bullets at Peronne almost as soon as the war began, was captured by the Germans but exchanged, recovered, and is now believed to be in Macedonia with his regiment of cuirassiers.

One of Philippe de Vilmorin's great services to genetics was the organization of the Fourth International Conference on Genetics, held in Paris, September 18–23, 1911. This conference was made possible largely by the de Vilmorin family, which furnished most of the necessary funds. Philippe was secretary, and on him fell a large share of the expense as well as work connected with meetings, entertainments, and publications. He issued for distribution to the members a pamphlet giving a brief history and bibliography of genetics, had bronze medals made for the foreign delegates, and edited the large volume of proceedings, the cost of publishing which was defrayed by him personally.

The most important of his published work in genetics has dealt with wheat. The breadth of his interest and information is shown by a publication on the beet-sugar industry of the United States, another on the culture of ginseng in Korea and Manchuria, and another on the tobaccos of commerce. He took a keen interest in flower gardening, and was responsible for three important publications of the firm: "Les Fleurs de Pleine Terre," "Le Manuel de Floriculture," and the "Hortus Vilmorinianus." The first two are standard works on flower gardening in Europe, while the third is a large and valuable report on the appearance and behavior of little known plants which the firm has tested at its various gardens.

While the influence of French workers in genetics has been large, the number of men actually engaged in this science has always been relatively small. Science can ill afford the loss of a man like Philippe de Vilmorin, who combined great wealth, high social position, and leadership in an immense business organization, with a profound enthusiasm for genetics, and who used all his possessions so freely to advance the science to which he had devoted his life.

A BUD VARIATION OF PITTOSPORUM

A. D. SHAMEL, *Riverside, California*

ONE of the most attractive and ornamental hedge plants grown in the vicinity of the writer's home at Riverside, Cal., is *Pittosporum tobira* var. *variegatum*, Ait. In addition to its use for hedges, it is occasionally found planted in gardens and lawns or along the roadsides as individual shrubs or trees and in tubs for house plants. Many visitors to this section of southern California from New England, and other places where the variegated pittosporum is a favorite house plant, remark upon the size and beauty of the plants when grown in the open in this sub-tropical climate. The plants frequently grow to 6 or 8 feet in height in this locality. The fully developed leaves are, on the average, about three inches long and about one and one-half inches wide. The leaves are entire and permanent, obovate in shape, and usually very obtuse. They narrow to a short petiole. The leaves are arranged in apparent whorls. The glabrous mature leaves are thick and have a leathery texture. Their color is usually light green and slightly paler beneath while the margins are revolute and are white or silver in color. The white areas are of irregular shape and size. The mass effect of the white margined leaves is highly ornamental and the individual shrubs make a beautiful showing during the entire year in this reigon.

The plants usually bloom here in the Spring and were in full bloom in 1917 during the last of April and early May. The flowers are usually light yellow in color and are arranged in terminal umbels. The calyx is made up of five sepals and the corolla of five petals. The tips of the petals are recurved. There is usually one style and one stigma. The capsules are very hairy, ovate, and the valves are made up of a resinous pulp. The flowers from a distance somewhat resemble orange blossoms in appearance and are rather fragrant. This variety rarely sets seeds here, if at all, and is usually, if not always, propagated from cuttings of partly ripened wood.

The variegated pittosporum is frequently subject to striking bud variations, as shown in Fig. 11. From this standpoint it is of very great interest to the writer. From the observation of many individual plants I have failed to find one, as yet, which does not show one or more branches of the green-leaved original. Most plants examined have been found to possess several such branches. In one case, for instance, the plant is almost equally divided, one-half being variegated, while the other half is not variegated. Again, on a neighboring plant one main lower branch is not-variegated while the remainder is almost wholly variegated. Further, other variegated plants show several small not variegated or green branches.

These observations led to a study of several *Pittosporum tobira* plants where frequent instances of variegated branch sports were found. The degree of variegation in these bud variations was marked, ranging all the way from branches bearing pure white, or almost pure white leaves, as shown in Fig. 11, to those having leaves with only very narrow and small white areas. Typical cases of variegated variations were found similar in appearance to the several strains of the variegated variety planted in the vicinity of Riverside.

The occurrence of the variegated bud variations of *Pittosporum tobira* and the fact that this plant is propagated by cuttings, offers a logical explanation of the origin of the variegated strains. Furthermore, upon inquiry amongst local propagators, it was found that the variegated strains in this region have been established by the propagation of the beautiful variegated bud variations of green-leaved *Pittosporum tobira* plants. It was also found that propagators have isolated not-variegated *Pittosporum tobira* plants by propagating

BUD VARIATIONS OF PITTOSPORUM

Green leaves are normal in the widely grown ornamental shrub, *Pittosporum tobira*, but variegations frequently appear and are propagated by cuttings. The branches shown above are from a single plant. The lowermost twig at the left is absolutely white except for one small section of green. The limb at the right shows that green branches and variegated branches may arise at almost the same point. Valuable commercial varieties of ornamental plants are secured by propagating bud variations of this sort. (Fig. 11.)

the green-leaved bud variations of the variegated plants.

The shape of the leaves of the not-variegated variety is more lanceolate than that of the leaves of the variegated variety. The green color of the leaves of the not-variegated plants is usually of a deeper shade than that of the variegated leaves. Hall[1] notes that this variety is said to withstand violent saline winds better than most other shrubs.

This presentation of the facts concerning the origin of the useful and beautiful variegated Pittosporum is for the purpose of calling attention to the possibilities of the study and utilization of bud variations for the propagation of valuable commercial varieties of ornamental plants.

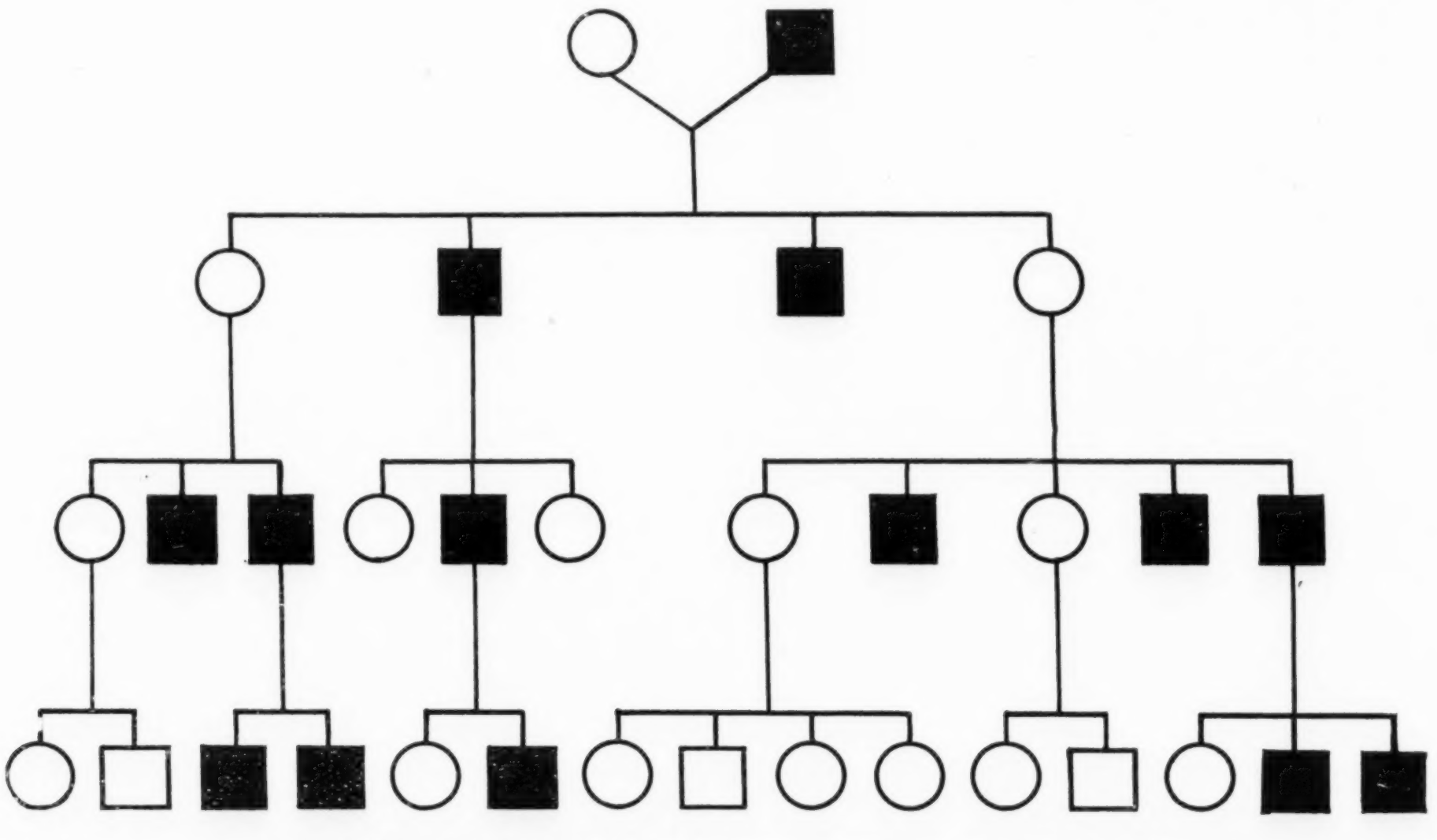
[1] Bailey's Cyclopedia of Horticulture, p. 2654.

INHERITANCE OF WHITE FORELOCK

S. J. Holmes and Richard O. Schofield
University of California, Berkeley, Calif.

THERE are a number of cases on record in which a lock of white hair has been traced through several generations. In general the white lock behaves as a typical dominant character, manifested by males and females alike.[1] In a family which has come to our notice, the white lock has been found to occur only in the males, although the females in the family, at least some of them, are capable of transmitting this peculiarity to their sons.

The lock occurs in the center of the fore part of the scalp. The region affected is about the size of a half dollar, and the hairs making the lock are slightly larger than those surrounding it and which may be of any general color. The lock is not evident in children, but makes itself manifest about the period of puberty. In all cases in this family the sons of affected males are also affected, although unaffected males might be expected to occur also. This distribution is in all probability due to chance. The females who are heterozygous do not manifest the white lock, but all of the daughters of the affected males have transmitted the character to their sons. Some of the females have no affected offspring, either because they are nulliplex or because their sons happened to escape.



PEDIGREE OF FAMILY WITH WHITE FORELOCK

Squares denote males and circles females; affected individuals are indicated by black squares. Not once in the family history has the forelock appeared in a female; the probability that this is not due to mere chance is very great. Other families have been studied, in which this white spotting factor affected both sexes alike. (Fig. 12.)

[1] The pedigree of one such family, extending over six generations, was published by Newton Miller in the Journal of Heredity, VI, pp. 165–169, 1915.

The character behaves apparently as a dominant in the males and as a recessive in females. Its transmission, therefore, is quite parallel to the inheritance of horns in the crossing of a breed of sheep in which only the males have horns with a breed in which both sexes are hornless. Owing, probably, to some hormone peculiar to the male sex, the white lock is manifest in the heterozygous males.

The development of hair in human beings is markedly influenced by sex, both as to its vigor of growth and extent of distribution. It is a noteworthy fact that baldness in man, according to recent studies of Miss Osborn,[2] behaves as a dominant in males and as a recessive in females. The limitation of the white lock to the males in the family which we have studied, may have some underlying association with the transmission of baldness. It is a curious fact, however, that it should be associated with the male sex in one family, while its transmission is independent of sex in others. In one pedigree described in Pearson, Nettleship and Usher's *Monograph on Albinism in Man* (Part 1, p. 265), a white occipital lock occurred only in males, but was transmitted through females. In each case the white lock skipped one generation, and in no case was the son of an affected male known to have exhibited the character. There were, therefore, a number of unaffected males in the family, but the whole pedigree is nevertheless consistent with the view that the white lock is dominant only in the male sex.

A PARALLEL AMONG SHEEP

There is no evident reason why a white lock should be associated with a particular sex in some families and not in others. The character is not sex-linked in the sense in which this term is applied to night-blindness and haemophilia in man, or to various characters of Drosophila. However, a parallel phenomenon is present among sheep, in which only the males of some breeds are horned, while both sexes have horns in other breeds.

Eugenics and Military Exemptions

The worst effect that a war has on any nation is to lower the average of its racial stock. It should be the object of every nation, therefore, to fight its wars with a minimum loss of its best stocks.

The draft act of the United States exempts the following: "persons engaged in industries, including agriculture, found to be necessary to the military establishment or the effective operation of the military forces or *the maintenance of national interests* during the emergency."

The nation will be justified in calling up the talent that is unreplaceable in various activities after it has exhausted the number of replaceable men who are equally good as soldiers, but not before. In addition, therefore, to the men who are necessary for the production of war supplies, there should also be exemption of those men whose trained abilities make them valuable to the national interests. These should not be drafted as long as there is plenty of material possessing physique, courage, and the fighting spirit. If called into military service, it is probable that these men will be used as mere privates, not as officers; and to place ability of a high order in the ranks in this way is unwisely jeopardizing the national interests. This is true not only from the standpoint of the present generation but still more from that of future generations.

Certainly with conscription within the narrow range of twenty-one to thirty, and not all men of this age used, it is indefensible to take men of extraordinary ability in any direction not utilizable in the Army, when the work can be done by men whose loss would be less felt by the nation.

Roswell H. Johnson,
University of Pittsburgh.

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[2] Journal of Heredity, VII, pp. 347–355, 1916.

ADULT CHARACTERS IN SUNFLOWER SEEDLINGS

T. D. A. Cockerell, *University of Colorado*

THE study of seedlings is obviously of practical importance. We want to be able to recognize the young plants coming up; to know the different kinds of weeds, in order to deal with them at the earliest possible moment. For such purposes, it is sufficient to be able to distinguish the genera and species in the seedling stage, and we are not particularly concerned with the varieties. When raising new varieties of sunflowers, however, we have had occasion to note the variation in the seedlings of the species *Helianthus annuus*, and to consider its meaning and importance. At the outset, we noticed that the *coronatus* variety, with chestnut red on the rays, could nearly always be distinguished as a seedling by the purple tint of the stalk and cotyledons. The stalk, or more properly hypocotyl, is usually deep purple, while the cotyledons show more or less of the same color. This enables the grower to pick out his red sunflowers almost as soon as they are up, and reject those which do not possess the desired character. Unfortunately the distinction is not valid for the vinous (wine-red) forms; why, we do not at present know. More recently, we have found various modifications of the cotyledons, showing structural as well as color differences. Four of these are now figured, and may be described thus:

Fig. A, A.[1] April 21, 1916. Seedling of var. *coronatus*, with one cotyledon strongly bi-lobed. At the angle between the lobes, on the under side (Fig. A[1]) is a sort of little pocket, surrounded by a swelling. The hypocotyl, margins of cotyledons, and a median band on the bi-lobed cotyledon, are dark purple. The small first leaves are hairy, and minutely speckled with purple.

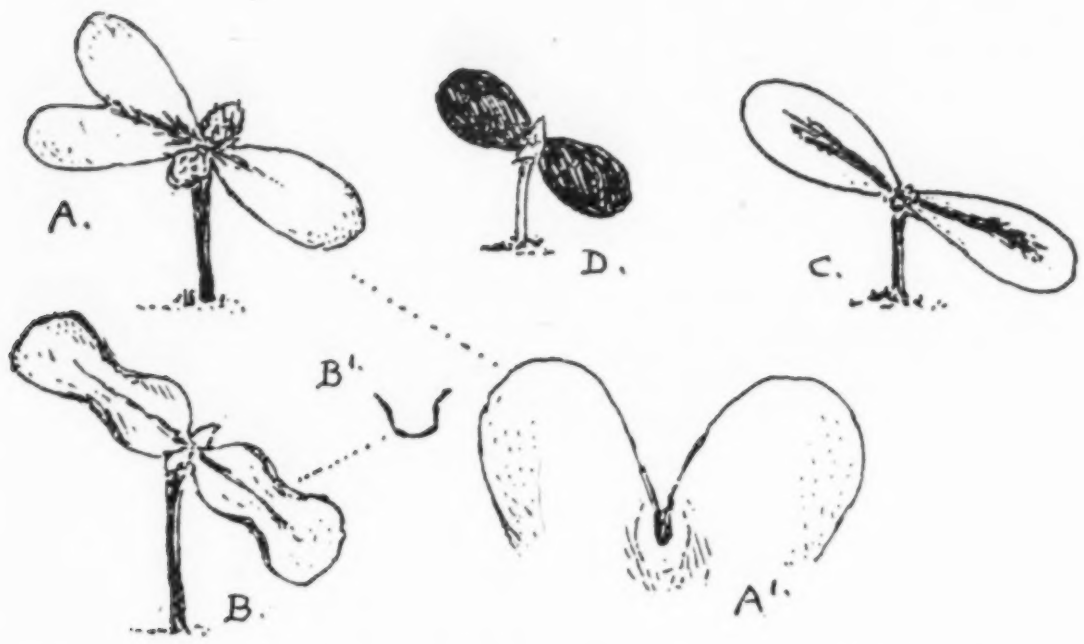
Fig. B, B.[1] April 23, 1916. Seedlings from Leonard Sutton of England, from vinous plants with quilled rays. About half these seedlings show an entirely new variation of the cotyledons, which appear fiddle-shaped, with the middle pinched in. They are not really narrower in the middle, but the margins are elevated (Fig. B[1], cross-section), giving the appearance shown. There is a variable dark purple median stripe, sometimes absent. On July 23 the plants were in flower, and were vinous bi-color, mostly rather pale, with normal rays.

Fig. C. April 11, 1916. Seedling of var. *coronatus*. The cotyledons have very conspicuous dark purple bands running down the middle, not reaching the apex. The margins of the bands are fimbriate toward the apex.

Fig. D. April 19, 1916. Grown in house. Seedlings of var. *vinosus* x (*annuus coronatus* x *cucumerifolius*); that is to say, one of the parents is a hybrid between *H. annuus* and *cucumerifolius*. Cotyledons above *entirely* dark plum color, small; first leaves light green, contrasting. April 22. Four plants with same history now up, two dark, two with green cotyledons. These all set out in garden, and on May 6 the cotyledons had grown considerably, and were now *green*, the purple having disappeared. First leaves light green.

We may consider these variations from two points of view. Are they connected with adult characters? Are they of any functional significance?

As to the latter question, it is not to be supposed that the modifications of shape have any functional importance. With regard to the color, the matter is not quite so clear, but the green seedlings in the lot described under D grew exactly as well and in the same manner as the purple ones. It is not possible to find any physiological advantage in the dark color, apparently. Indeed, Miss Wheldale, in her important new work on "The Anthocyanin Pigments of Plants," after devoting a chapter to the physiological significance of antho-



VARIATIONS IN SUNFLOWER SEEDLINGS (Fig. 13.)

cyanins, is obliged to conclude: "The pigment is produced, of necessity, in tissues where the conditions are such that the chemical reactions leading to anthocyanin formation are bound to take place. For the time being we may safely say that it has not been satisfactorily determined in any one case whether its development is either an advantage or a disadvantage to the plant."

As regards the other matter, the characters observed are evidently inherited like other characters, and appear to segregate in a mendelian manner, as shown by the occurrence of both normal and variant types, without intermediates, in two cultures. In Holland, deVries had a race of sunflowers producing syncotylous seedlings, with the two cotyledons united. He found that the character was inherited, though he could not isolate a pure race. Thus the peculiarities of these seedlings must be due to germinal factors, or determiners, which cannot be confined to the seedling stage; yet the manifestation of their effects may be limited to that stage. Just as in insects (moths and beetles, for example) the larvae may show marked differences, while the adults are *apparently* alike; so in plants the seedling stage *may* be the only one in which the existence of particular hereditary factors is revealed. On the other hand, the seedling characters *may* be obviously correlated with adult ones, and it is not impossible that, sometimes, the failure to observe any correlation is due to a lack of similarity between the effects produced at different ages.

A Book for Family History

OURSELVES, A personal and family history register for preserving records of a private and personal nature, for one married couple and their children. By John Madison Taylor, A. B., M.D: Quarto, price $5.00 net. Philadelphia: F. A. Davis Company, 1917.

There has long been a need for a book in which families could record their pedigree and family traits, and Dr. Taylor's large volume can be recommended for this purpose. It has ample space for genealogical charts and data, and provides blanks and suggestions for making a complete record of the development of children. It is free from over-elaboration of detail, although amply full, and its simplicity ought to appeal to many parents. The value of keeping such a family record as this is recognized by every eugenist, but it is probable that few have put their convictions into practice. With Dr. Taylor's "family account book" available, one of the principal excuses for not keeping a proper family record is removed.

ANTS AND APHIDS

The Remarkable Relations Existing between Them—Aphids Act as "Cows" for the Ants, in Return for Care and Protection—A Baffling Problem of Heredity

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OF ALMOST fifteen hundred insects, spiders and crustaceans who have unusual amicable relations with the ants or who live in the same nest with them, none is of more interest than the common aphis. Mealy bugs, tree hoppers, lantern flies, and certain species of caterpillars also live in the same relationship, but the relationship in the case of the aphis is most apparent.

Aphids live on practically every form of plant life and on every part of the plant, including the roots, stems and leaves. They pierce the integument of the plant with their hard and sharp mouth-parts and suck the juices, which consist of water, cane sugar, invert sugar and possibly a slight amount of albuminoid matter.

The juices pass through the alimentary canal of the insect, where a slight portion is absorbed, the rest undergoing a chemical change wherein the cane sugar is turned to invert sugar or glucose. The changed plant juices are then voided through the anal opening in the form of colorless droplets.

Réaumur in 1737 and Leche in 1765 were the first to ascertain the true origin of these droplets, which often collect on the leaves in vast quantities. The linden aphis was found by Büsgen (1891) to void nineteen drops in the course of twenty-four hours, while the maple aphis excreted as many as forty-eight drops in the same time. This is a surprisingly large quantity considering the small size of the insects.

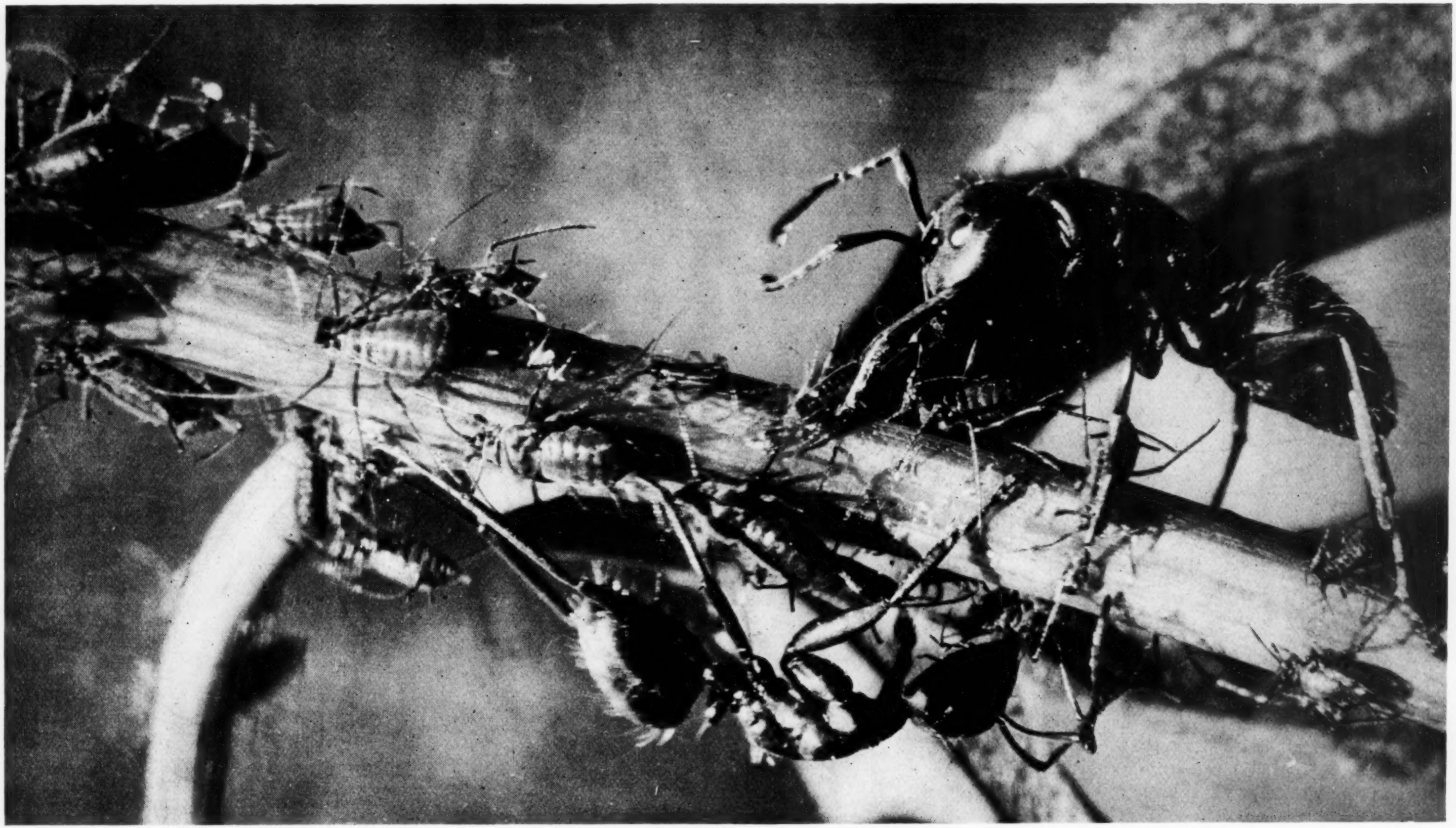
This voiding of "honey dew" furnishes the ant with a never failing supply of nutritious and, to it, delightful food. Some species merely lick the leaves on which the dew has dropped, others do not appear to hunt for the liquid at all, but most ants learn to stroke the aphids in order to make them void the sought-for food, just as a cow is induced by the hired man to "give down" milk. Thus the honey dew can be imbibed directly. Some ants are found to live exclusively in this manner.

THE ANTS' PROCEDURE

When desiring food, the ant caresses the abdomen of the aphis with first one and then the other antenna. The aphis immediately voids a droplet of honey dew, which is at once seized by the ant, who goes on to another aphis and repeats the operation. If the second aphis fails to respond the ant perceives that nothing is to be expected, since the aphis has no honey dew left at that moment, and goes on to another. Five or six such repasts are sufficient to satiate the ant, and she returns to the nest. If the aphis does not receive sufficient attention from the ants, it voids the droplet without waiting to be stroked. In this case, the droplet is ejected forcibly some distance, which is not the case when it is given directly to the ants after stimulus.

The ants sometimes exhaust the aphis' supply of honey dew and then have to wait until the aphis can pump up a fresh supply from the plant. The aphis is very generous, however, and will often yield several droplets in succession to different ants.

Some aphids have on the sixth abdominal segment a pair of tubules, and it was the idea for a long time that these were the source of the honey dew. This has now been proved false. The excretion of the tubules is yellow and sticky and is used as a protection against the lady-bird beetle, the so-called aphis-lion, and other hereditary enemies of the aphis. When the enemy attempts to seize the aphis, the latter immediately excretes the defensive liquid from the tubules, smearing the head and thorax of the beetle with it. This usually frightens, blinds or dis-



ANTS "MILKING" THEIR APHIDS

The aphids live on the juices of plants, and excrete drops of honey dew, a weak syrup. The ants protect them from enemies, build nests for them, and care for their eggs and young. When an ant wants a meal, he goes to an aphis and strokes it, whereupon the aphis emits a drop of honey dew, which the ant drinks up. Half a dozen aphids will thus supply the ant with a square meal. Photograph by Brown and Dawson. (Fig. 14.)

concerts the attacking party to such an extent that the aphis has a chance to make its escape.

The manna of Biblical tradition is now known to be the honey dew of a species of coccid, or mealy bug (*Gossyparia mannifera*), which lives on the tamarisk. It is still eaten by the Arabs, who call it "man."

HISTORY TOLD IN AMBER

It is found that the same relations existed between the ants and aphids in prehistoric times as now. Blocks of amber which are perhaps 2,000,000 years old sometimes contain the ant and aphis together, and with other evidences make it sure that then as now, the ant depended largely on the aphis for food. At present, seventeen species, including nine genera of aphids, have been observed being "milked" by ants.

Since the ants derive an easily obtained and close at hand supply of nutritious food from the aphids, it is but fair that they should render equal if not similar services to their allies. And that the relationship is mutualistic is made evident in many ways.

The ants protect the aphids in every way possible; they fight their enemies; they build tents to protect them; they carry them away to a place of safety in times of danger; they take the eggs to their own nest for the winter, see that they receive careful attention and are hatched at the proper time; place the newly hatched food purveyors where they can get an abundance of good succulent leaves and take them back to the nest in case of sudden cold weather, and at all times see that nothing is lacking for the comfort of their charges.

The aphids never try to escape, but on the contrary the females, when they desire to lay their eggs, often wait until found by ants who clip their wings (their exact reason for doing this being uncertain), and carry them into underground chambers, where the eggs are laid by the aphis and taken in charge by the ants.

The ants always stroke the aphids in the same peculiar manner and know just where to expect the liquid. The unusual care which the aphids are given often makes it possible for them to produce as many as sixteen generations during a summer, ten of which may be under the care of the ants simultaneously.

How the ants have come to handle the aphids in this manner has long been a baffling problem. Presumably the behavior is instinctive, but how did it arise? It has often been suggested that it is the result of habit which becomes hereditary—that is, an example of the inheritance of acquired characters. But most of the ants which show this specialized behavior are workers, sexually imperfect females who never leave any offspring. It is, therefore, quite impossible that they should transmit their training to offspring which they do not have. On the whole, no satisfactory explanation has been suggested to account for the origin and inheritance of the ants' habits.

New Egg Records in New South Wales

Egg-laying records are improving each year in the New South Wales competitions, the fifteenth of which closed this spring. A pen of six White Leghorns set a new mark by laying 2,647 eggs in two years, of which 1,231 were laid in the second year. The best individual record of a hen was 312 eggs in 365 days by a Black Orpington. This is much less significant, for the progress of the poultry industry, than the averages. There were 420 pullets of all breeds, which laid an average of 206 eggs each, in their first year. This achievement was largely due to the excellent care the birds received, but fundamentally to the fact that they came from selected stock. It shows that the egg-production of a country which has advanced far, by present standards, might yet be doubled if the most scientific methods were employed.

FOR THE GIFTED CHILD

Public Schools Are Beginning to Realize the Need of Special Provision for Pupils Who Are Above the Average—Few Make Any Real Study of the Capacities of the Unusual Boy or Girl

HOPE for the eugenic advancement of the race lies in those members of it who are inherently superior, and eugenists are, therefore, anxious that every gifted child shall be recognized and have a chance to develop to the utmost.

For some years retarded and defective children have principally occupied the interest of educational reformers, and much has been done to benefit them—almost too much, in fact, for often feeble-minded children have been painfully nursed up to adult age and have founded families, also often mentally defective; while the superior child has had to support his weaker brothers and sisters, and his chance to establish a family which would have been of more than usual value to society, has thereby been limited. A large mass of literature has been published in regard to the special care and education to be afforded the mentally unfit, while very little has been done to give appropriate opportunities to those with exceptional ability.

Now, however, educators are beginning to realize that while the defective needs a special chance if he is to hold a place in the world, a chance offered the mentally superior will enable him to advance far beyond the average sphere of intelligence and usefulness. The same time and money spent in raising the mentality of the defective will produce a much larger comparative increase in the superior child.

A questionaire was recently sent by Dr. Elizabeth Woods[1] to school superintendents throughout the United States asking what provision they make for exceptionally gifted children.

Of the 549 cities answering, 288 are making some provision for the mentally superior children, generally in the form of an elastic promotion, to be made when the child is able to take up the advanced work. In addition to this, 167 cities which stated they made no provision for the advanced pupils were found to be using some elastic promotion system, whereby the mentally superior are really accorded a chance. Further, eighty-three which neglected to answer the question were found to be using a similar system.

Of the 167 superintendents who reported no such provision in their system, 67%, or 111, were emphatic in stating that there was urgent need for it.

VARIOUS SYSTEMS USED

Various systems have been adopted in an effort to assist the unusually bright child in acquiring all the knowledge he can assimilate. Many cities report special classes for their gifted pupils; some have summer classes; others divide up the pupils in the grade, without segregation. The subjects taught are usually those of the regular curriculum, but often election of language, science or business courses is allowed.

In some classes, the mentally bright are allowed to do more intensive work than the average student. Some segregated classes contain both backward and bright students, and the teacher's time is given to helping the students individually. Often it is made possible for students to pass the last three years' work in two years.

With but one exception in all the cases reported, the only special training required of teachers is unusually successful teaching experience. In some instances,

[1] Woods, Elizabeth L. Provision for the Gifted Child. *Educational Administration and Supervision*, pp. 139–149, March, 1917. Dr. Woods was formerly in the department of psychology at Vassar College, but is now psychologist of the Pasadena (Cal.) city schools.

Normal School students assist in the personal help of the pupils. Some cities have one or more unassigned teachers, who go where their efforts are expected to prove most helpful.

Only eighteen cities make use of psychological tests in the selection of pupils for special training. Most of the students are selected simply on their school records, sometimes with the recommendation of the principal or superintendent. Thus, most selections are made on what the pupil has done with no special incentive to unusually good work, rather than on what he could do under more avorable conditions.

The psychological tests used include the Binet-Simon, Healy, Yerkes Point Scale, Woodworth-Wells, Whipple, Thorndike, Courtis, Ayres, Stone, University of Nebraska and some others. Many of these tests are educational rather than psychological, and except in one city they are administered by the principal or superintendent; although many cities employ trained psychologists to make special tests of defectives.

SUMMARY

To sum up the results arrived at, every city in the United States of over 8,000 population was reached; 549 out of 766 cities answered, or more than 71%; 402 or 73% have elastic promotion systems or other aids for the exceptionally bright children; 31% or 124 of these cities consider their present provision entirely inadequate.

Of those reporting, 174 or 31% have made some provision other than elastic promotions for the atypic child; 45 cities have classes for gifted children only; 77 cities have classes including both gifted and other "irregular" children; 36 cities have divided their regular classes according to mental ability; 16 cities have teachers whose entire time is given up to the personal training of either defective or superior pupils.

Less than 0.5% (3) of the superintendents answering the questionaire disapproved of the separation of the mentally superior; more than 24% were emphatically in favor of it, while many others who made no definite statement, must approve of it in view of the work they are doing.

As yet there is little attempt made to determine the special gifts o the unusually bright students—they continue the work of the regular grades, perhaps more intensified. A few schools permit the election of art, science, language or business by bright students of the higher grades. But sentiment appears to be growing more and more in favor of developing the child according to his particular aptitudes.

The change in the attitude of educators is evident. Soon, it is to be hoped, the principal attention will be centered no longer on the inferior, who can rarely be brought up to par, but upon the superior child, who with additional opportunities can develop into a far greater sphere of usefulness to society than if forced to take the same mental foods and stimulants as the dull or even the normal.

Eventually every well-equipped school system will provide expert psychologists who will diagnose and classify the students and will recommend suitable training and opportunities for the mentally superior. Then will the rate of advancement be for each student that which he individually is capable of sustaining. Then will the children above the average ability have ample chance to satisfy their thirst for knowledge, and children with special aptitudes or decided bents in particular directions will not be denied, as heretofore, an opportunity to make the most of what they have in them.

THE FIREFLY'S LIGHT

A Remarkable Structure that Seems in Some Cases to be of Little Value to Its Possessor—Possibly a By-product of Evolution—Serves in Many Cases as a Signal between the Sexes

FEW insects possess a more remarkable mechanism than the lighting apparatus of the firefly. It might be supposed that the evolution of such a mechanism would be of life-and-death value to its possessor. But it is difficult to see that it has such a value to the firefly. Its existence is possibly more or less an accident of evolution; but now that it is here, the firefly makes use of it, at least in some species, to find its mate.

The fireflies, which are in reality not flies but beetles, are found through the eastern and southern part of the United States almost any warm summer evening. There are two principal forms, which nearly always occur together; *Photinus pyralis* and *Photuris pensylvannica*, both members of the family Lampyridae. There are several other more insignificant species, which are so like these two as to require no separate description.

Photuris is strong and hardy, carnivorous, eating dead comrades or enemies with no discrimination, and generally flies at some altitude, especially among the tops of tall trees, flashing only occasionally, and sometimes moving several rods before again emitting its light. For some reason, males are much more infrequently taken than females, and captures which have been made have been found to average but one male for every fifteen females. The light-emitting organs are almost identical in the sexes.

Photinus is the more plentiful, and flies nearer the ground, flashing frequently. It is easily injured, and being so delicate is hard to keep in captivity, while Photuris will live well indefinitely if provided with a little sod. The male Photinus has much larger photogenic organs than the female, and hence the sexes are easily distinguished. The most characteristic flash of Photinus consists of a long fulmination of yellow light.

The photogenic organs of Photinus are the more complicated of the two species. Two small roundish spots appear on the next to the last abdominal segment in both sexes, these spots giving off a greenish light. In the male, the second and third posterior segments are also composed of photogenic cells, while in the female, an oval splotch on the third segment emits light, the rest of the segment not having this power.

The light emitted from the two small round spots in each sex is distinctly greener than that from other segments of the abdomen, but the cause of this is not clearly understood. It seems possible that the color depends upon the intensity of the light, but experiments have shown that often the green light is the brighter of the two, still retaining its greenish color. The color of the light seems to be useful as a distinguishing mark of the different species, no two emitting an identical shade.

It must be remembered that the light of such a beetle might and probably does have an entirely different effect on the compound eye of insects than it does on the simple eye of man. In all study of the light of the Lampyridae, this must be taken into consideration.

USE OF THE LIGHT

Many suggestions have been made as to possible or probable uses to which this light-emitting power is put by the

[1] The tropical fireflies belong to another family, the Elateridae or click-beetles. *Pyrophorus noctilucus* is the principal species. Its glow is continuous, not intermittent.

THE UNDERSIDE OF A FIREFLY, GREATLY MAGNIFIED

The light of the firefly comes from the two yellow segments near the tip of its abdomen, as everyone knows who has examined such an insect at night under a hand lens. The light-making apparatus of the male (shown above) is larger than that of the female. Fireflies lay their eggs just under the surface of the soil, and the carnivorous larvae hatch out in a few weeks. They hibernate under stones, spend three weeks in a pupal stage, and then emerge as adult fireflies. The light-producing tissue can sometimes be detected even in the egg; it is supposed to be a modification of fat tissue. Photograph, twelve times natural size, by John Howard Paine. (Fig. 15)

insect. The light might serve to attract prey; it might illuminate the path of the insect; its prey might be blinded by the brilliant flash, and thus its escape be prevented; enemies might be blinded similarly, so that they would be unable to attack the torch bearer successfully; some think it may serve only as an adornment; but the last and most plausible view of the matter is that it serves as a signal between the male and female of the same species.

"At night the males leave their concealment and fly about. A little later the females ascend to the tops of blades of grass and remain there without glowing. A male passes by and flashes his light; the female flashes back. Instantly he turns in his course to the spot whence the signal came and alights. He signals again. She replies. He ascends the blade, and if he cannot find her, he signals again and she responds. The signals continue until the female is found, and the drama of sex is finished.

"Mast has recently shown that the female firefly does more than simply respond to the signal of the male. If a male flies above and to the right of the female, she bends her abdomen so that its ventral surface is turned upward and to the right. If the male is above and to the left, the light is turned in this direction. If the male is directly above, the abdomen of the female is twisted almost upward. But if the male is below her, she emits her light without turning her body."

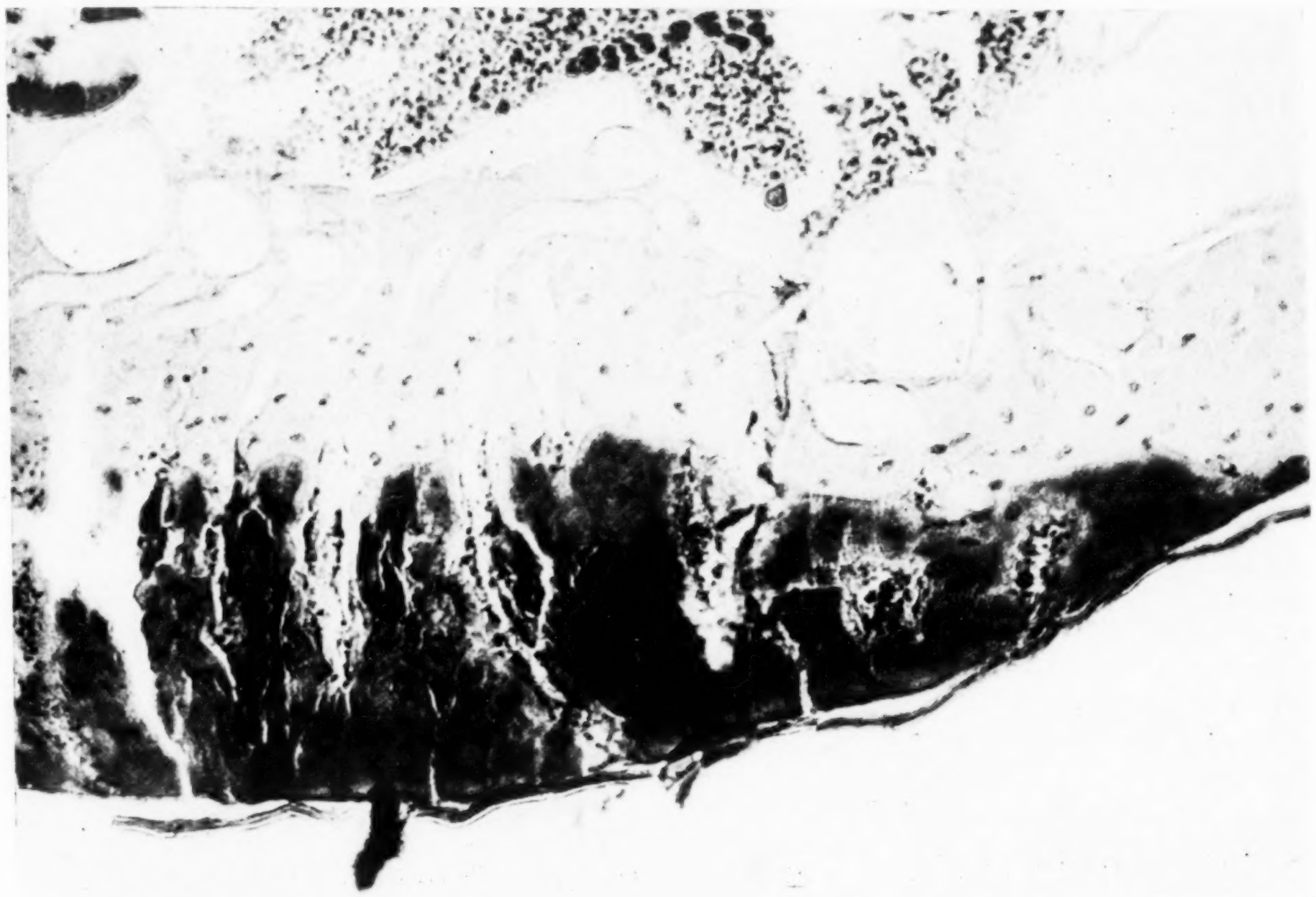
If a number of females are caught and placed in a bottle out of doors on a suitable night, members of the opposite sex will often fly up and light on the coat of the person holding the bottle. It might appear that this is due to an odor emitted by the females which could remain on the person handling them, but the following experiment of S. O. Mast demonstrates conclusively that the light is the determining factor. If a female is placed where the reflection of her flash may be seen in a mirror by a male, he will start for the mirror every time she flashes, even if some color screen be interposed. This brings up another question, how the male can determine whether the flash is that of a female or not, if its color be thus changed. It seems probable that the duration of the flash is in this case important, and many observers have deduced that the flash of the female differs slightly in duration from that of the male, although often the difference is imperceptible. In some species the male emits two short flashes consecutively, while the female emits one long fulmination of light. In such a case, the duration of the flash would explain the matter satisfactorily, and it seems probable that differences detected by the insects might be too minute for the human eye to observe.

CONTRADICTORY CASES

In one species of Lampyridae, the larva possesses photogenic power while the adult does not. In such a case, the light can hardly be a secondary sexual character. Furthermore, the glow-worm frequently mates in the day time, when the light would be of practically no use. But evidence points strongly to the fact that the flash is of assistance to the male in locating his mate in many instances.

But whatever its use, the mechanism which produces the light is perhaps more of a mystery than the use itself. The structure of the photogenic apparatus is apparently the same in all species. As heretofore mentioned, in Photinus, the male has more fully developed photogenic organs than has the female, while in Photuris, both sexes are equally provided. When the flash is emitted, the entire abdomen generally glows, but this is due to part of the photogenic apparatus, and not to any fluorescence of any part except the definitely marked photogenic areas of the abdomen.

Throughout all of the light organs, fine tubes are found, connected with the main air system and evidently the pathway of oxygen. This would seem to indicate that oxidation is the source of the light, and that air is forced through the fine passages in the photogenic tissue, where the oxidation might take place. If one part of the light organs is paralyzed by pressure, it will not flash but merely glows, while the



HOW THE LIGHT OF THE FIREFLY IS PRODUCED

Cross-section of lower part of a firefly's abdomen, magnified about three hundred times. The dark tissue at the bottom produces the light; it is backed up internally by a reflecting layer, which appears very light in the photograph. The small dots in this layer are the nuclei of the cells of which it is composed. The reflecting layer diffuses the light and may also serve to guard the insect from injury by its own illumination. Throughout the two layers can be seen the canals or trachea which conduct air—for oxygen appears to be necessary to oxidize the light-producing substance of the firefly. Photomicrograph by John Howard Paine. (Fig. 16.)

other unparalyzed parts will go on flashing as usual.

Between the light organs and nervous system intervenes what is called a reflecting layer. This layer does not directly reflect, however, but rather diffuses the light so as to make the entire abdomen appear as though glowing. This layer may protect the nervous system from some possible bad effects of the direct light, and many think it serves still another purpose of being the storehouse for some substance which plays an active part in the light production. Whether or not it contains the stored-up supply of oxidizable materials, however, must still remain in the realm of conjecture.

The photogenic property of the abdominal segments is independent of life, for if the organs are dried and ground to powder, light reappears under the influence of air and moisture.

Often the photogenic properties may be observed in the eggs while they are still in the ovaries, and nearly all the larvae of the illuminating species show fluorescence. Does the insect store up "fuel" in its earlier stages which gradually becomes exhausted during the use of the light-emitting apparatus when adult? There is some slight evidence to show that this might be the case, but sufficient knowledge has not yet been gained to make it possible to reach any definite conclusion.

INTENSITY OF THE LIGHT

The intensity of the insect's light is remarkable. It varies greatly, but the most reliable tests made on the insects frequenting Washington, D. C., place

the candle power of the glow at 1/50,000 and that of the flash at 1/400. Although this seems a small amount, in comparison with the size of the insect it is truly surprising.

There are practically no invisible rays in the firefly's light, and hence no heat and a remarkable efficiency. The efficiency of Photinus has been rated from 90% to 96.5%, while the efficiency of a carbon glow lamp is but 0.4%, and the most efficient form of artificial illuminants produced by man are but 4% efficient. Nothing is known about the energy input of the insect, but the resulting light is the most efficient known to science. To supply an equal amount of light from the same illuminated area in the laboratory would require a temperature of 2,000° F.

If the insect is forced by stimulation to keep flashing continuously, life soon becomes extinct, apparently from exhaustion. This indicates that the energy input is considerable on the part of the insect; it is also possible that there may be some reservoir of stored-up light energy which cannot be replenished indefinitely.

There is apparently absolutely no radiation of heat during the flashing, as measured by the most accurate means obtainable, which practically preclude the possibility of error. No infra-red rays are thrown off, for if there were, the insect would soon be dessicated by its own heat. The body temperature of the photogenic segments is higher, however, than the temperature of other parts of the body.

Popular opinion frequently to the contrary, the light of the firefly is connected in no way with any "phosphoresence" or "X-rays." It seems most probable that it is the result of the presence of moisture, oxygen and some unknown substance, possibly a fat or an albuminoid, together with some form of oxidation taking place. Unless some startling and heretofore undiscovered endo-thermic action is going on whereby light is emitted, there seems to be no other possible explanation of the fluoresence. Some observers have suggested phosphuretted hydrogen or carbon to be oxidized, while some think the light to be the result of the breaking down of some nitrogenous substance to form crystalline urates. Every opinion is backed by some evidence, but none is based upon sufficient grounds to make it entirely plausible from every point of view, so that the whole matter is still as much in doubt as ever.

The Psychology of Special Abilities and Disabilities

THE PSYCHOLOGY OF SPECIAL ABILITIES AND DISABILITIES, by Augusta F. Bronner, Assistant Director of the Juvenile Psychopathic Institute, Chicago. Pp. 269. Price, $1.75. Boston: Little, Brown & Co., 1917.

Psychologists as well as eugenists have lately been emphasizing the fact that no two children are alike, but the schools have found it difficult to act on this fact. Dr. Bronner's book presents the problem of individual differences clearly and strikingly. She describes many detailed cases, and discusses the general principles involved, where a subnormal child has special ability in some particular line, and deals more shortly with children who are normal in most ways but in whom some one mental function may be defective. The book is so simply written that it will appeal to parents and teachers, as well as to specialists; but the former should be warned that they may easily get a false idea of individual differences, because of the emphasis which Dr. Bronner lays on extreme cases. As a fact, good qualities usually go together, and bad qualities usually go together. A child who is deficient in several mental functions is more likely than the average to be deficient in all mental functions. Intelligence tends to form a *level*, instead of a system of peaks and valleys, but an unguarded consideration of the selected cases Dr. Bronner presents might lead the reader to think the reverse is the case.

COLOR INHERITANCE IN MAMMALS

II. The Mouse—Better Adapted to Experimental Work than Any Other Mammal—Seven Sets of Mendelian Allelomorphs Identified—Factorial Hypothesis Framed by Cuenot on Basis of His Work with Mice

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IN THE first paper of this series,[1] a classification of color factors in mammals was suggested on a hypothetical chemical basis. A general discussion was given of the factors belonging to each class. The present and following papers attempt to give a more detailed analysis of the present state of our knowledge on the subject in each of the mammals on which work has been done.

By far the most experimental work has been carried on with four rodents—the mouse, rat, rabbit and guinea-pig, and the factors have been determined with very much more certainty than in the larger animals. A few facts are known in regard to other rodents.

Among the larger domestic animals it is a curious fact that the amount known is in inverse relation to the difficulty in breeding. The color factors of the horse have been quite thoroughly worked out. Cattle stand next, while in sheep, goats and hogs our information is rather scanty. The reason for this inverse relation is easy to understand. Just because of the slowness of breeding horses, there has been, for the most part, but little attempt to fix the colors in the different breeds. Thus stud book records show all kinds of matings with segregation of the colors in the offspring. The breeds in cattle have been fixed in color to a greater extent than in horses but the Shorthorns and Highlands, at least, continue to produce several colors. In swine, each breed has its characteristic color and nothing can be learned from the records. In European breeds of sheep, all colors have been nearly eliminated except white, owing to the greater desirability of this color for wool. Other colors exist as in the tan and black Barbados, but little is known of their inheritance.

Dogs and cats are even richer in color varieties than the rodents, but the factors are none too well understood. Finally in man, the problems in color inheritance appear to be of an unusually difficult nature.

CLASSES OF COLOR FACTORS

In the previous paper color, factors were classified into four groups defined as follows:

1. Factors which affect distribution and intensity of color, largely irrespective of the kind of color.

(*a*) Factors which affect the distribution of color in contrast with white.

(*b*) Factors which affect the intensity of color in all colored areas of the skin, fur and eyes.

2. Factors which affect the distribution and intensity of the differentiation from yellow to black—effects, of course, visible only in colored areas.

(*a*) Factors which affect the distribution of a dark color (black, sepia, brown, etc.) in contrast with a yellow.

(*b*) Factors which affect the intensity of only the dark colors with effects visible wherever such colors develop in skin, fur and eyes.

In a more detailed study of the factors a rough subdivision of classes 1a and 2a becomes convenient. This gives eight classes which may be defined briefly by the following list of characteristic variations.

[1] Wright, S. 1917. JOUR. HEREDITY, 8:224–235.

		Example
$1a_1$	White pattern (roan type)	roan cattle
$1a_2$	White pattern (piebald type)	Dutch rabbit
$1a_3$	Dilution of all colors (maltese and light red type)	blue rabbit
1b	Dilution of all colors (sepia and cream type, albinism)	dilute guinea-pig
$2a_1$	Yellow pattern (agouti type)	gray rabbit
$2a_2$	Yellow pattern (tortoise type)	tortoise guinea-pig
$2a_3$	Density of black (sooty type)	sooty rabbit
2b	Dilution of black only (brown type)	brown mouse

While the lines between these classes especially between $2a_2$ and $2a_3$ cannot be drawn very closely, most factors are readily placed.

In the discussions of the different mammals, a list is given of the Mendelian factors which have been thoroughly demonstrated in the opinion of the writer. They are classified according to their apparent physiological effects under the scheme above. The effect is given in more detail by a brief description of the color variety which differs by only the unit factor in question from a certain type, that of the wild species, where this is known. The color of a variety which differs from the type by more than one factor is easily deduced in all cases. Thus a mouse which differs from the gray color of wild mice only by factor s is a piebald gray, by factor b is a cinnomon gray in which the black parts of the fur are changed to brown, while a mouse which differs by both is naturally a piebald cinnamon. Where the two factors are in the same class, a double effect is produced. Thus a mouse like the wild in formula except for factors p and b has a double dilution of black, the black parts of the fur becoming very pale brown.

No wholly satisfactory system of symbols for Mendelian factors seems yet to have been devised, and there is little uniformity among authors. Where only a pair of allelomorphs is known, the present paper follows the convenient system of representing the dominant factor by a capital, the recessive by a small letter. The same letter with different subscripts is used for systems of multiple allelomorphs.

GRAY MOUSE—SvICABP

(Pattern of black and yellow)

$1a_1$	—	
$1a_2$	S,s	s piebald
	V,v	Vv piebald, ssVv black-eyed white
$1a_3$	I,i	i pale gray (blue and light yellow)
1b	C,c	c albino (white with pink eyes)
$2a_1$	A_y, A_L, A, A_b	A_y yellow, A_L light bellied gray, A_b black
$2a_2$	—	
$2a_3$	—	
2b	B,b	b brown-eyed brown agouti (brown and yellow)
	P,p	p pink eyed agouti (lilac and yellow)
		Unanalyzed
$1a_2$		Blaze and minor variations in piebalds
1b		Cream in place of yellow or red
$2a_3$		Black or sooty yellow in place of yellow as in sables and black and tans

THE FACTORS OF MICE

In many respects mice have been found to be better adapted for experimental work than any other mammal. From the first they have attracted a great number of investigators, among whom first place must be given Cuénot[2] whose work has had a most profound influence on genetic theory apart from its bearing on inheritance in mice. The results are in harmony on most points and the essential facts may be considered as very thoroughly established. Seven sets of Mendelian allelomorphs, as listed above, have been identified. At least two important series of variations do not seem to follow simple Mendelian inheritance and have so far defied analysis.

Excluding the second piebald factor, each of the other six sets of allelomorphs

[2] Cuénot, L. 1902–11. *Arch. Zool. Exp. et Gén.* (3), 10; (4), 1, 2, 3, 5, 6, 8.

has been combined with others in such a way as to demonstrate its place as an independent set. The second piebald factor does not appear to have been combined with the brown and dilution series, but will no doubt be found independent when so combined. The agouti series of four allelomorphs was discovered by Cuénot[3] and thoroughly confirmed by Sturtevant,[4] Morgan,[5] and Little.[6]

There remains to be considered the possibility of linkage between the different series of allelomorphs. The linkage relations of the piebald factors do not seem to have been thoroughly investigated except that Little[7] has shown them to be nearly or quite independent of each other, and the first one is known to be independent of albinism (Cuénot,[8] Allen,[9] and Durham.[10]) Dilution, non-agouti, brown eye and pink eye were shown to be without appreciable linkage in a four-factor cross involving very large numbers made by Little and Phillips.[11] These results are also in harmony with those obtained by Cuénot and Miss Durham. The relation of albinism to the others has not been worked out very thoroughly, but one case of partial linkage here is very probable. Darbishire[12] crossed pink-eyed colored mice with albinos from dark-eyed strains (CCpp x ccPP). F_1 were all dark-eyed. In F_2 there were 137 albinos, 284 dark-eyed and 134 pink-eyed colored. Darbishire recognized the closeness to a 1:2:1 ratio. This is to be expected on complete linkage, but not on independence, in which case the ratio should be 4:9:3. Cuénot,[13] in the same cross, obtained 21 albinos, 46 dark-eyed and 25 pink-eyed colored, in close agreement. Combining, the ratio of dark-eyed to pink-eyed is 330:159 with a deviation of 5.7 times the probable error from the expected 3:1 ratio. Tests of F_2 individuals bear out the theory of linkage, but also show that linkage is far from perfect.

PIEBALD MICE

Some very interesting work has been done on piebald mice. The pattern is variable in extent, and apt to be markedly asymmetrical. All variations exist between self and black-eyed white. Cuénot[14] showed that the pied character behaves in general as a Mendelian recessive to self and is inherited independently of albinism or the quality of color of the mouse. These results have been confirmed by all later workers. Cuénot recognized that much of the variation is merely developmental, being unrepresented in the germ plasm. He suggested, however, that a series of multiple allelomorphs such as he had found in the yellows and agoutis was responsible for the gradations. That such allelomorphs may exist is very probable in view of conditions found in rats, but it has never been critically demonstrated. On the other hand, another piebald factor has been discovered which has been shown by Durham,[15] Little,[16] and Detlefsen[17] to be independent in inheritance, but to coöperate with the first in development. The case has been most thoroughly worked out by Little who found that the second piebald factor could not be obtained in a homozygous condition, thus resembling the well known case of the yellow mice. The situation as he found it was as follows:

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[3] Cuénot L. 1904. *Arch. Zool. Exp. et Gén.* (4), 2, Notes et revue 45–56.
[4] Sturtevant, A. H. 1912. *Amer. Nat.*, 46:368–371.
[5] Morgan, T. H. 1914. *Amer. Nat.*, 48:449–458.
[6] Little, C. C. 1914. *Amer. Nat.*, 48.
[7] Little, C. C. 1915. *Amer. Nat.*, 49:727–740.
[8] Cuénot, L. 1904. *Loc. cit.*
[9] Allen, G. M. 1904. *Proc. Amer. Acad. Arts and Sci.*, 40:61–163.
[10] Durham, F. M. 1908. *Rept. Evol. Com. Roy. Soc.*, 4:41.
[11] Little, C. C. and Phillips, J. C. 1913. *Amer. Nat.*, 47:760.
[12] Darbishire, A. D. 1903, 1904. *Biom.*, 2:101–104, 163–173, 282–285; 3:1–51.
[13] Cuénot, L. 1907. *Arch. Zool. Exp. et Gén.*, (4), 5. Notes et revue, p. 1.
[14] Cuénot, L. 1904. *Loc. cit.*
[15] Durham, F. M. 1908. *Loc. cit.*
[16] Little, C. C. 1915. *Loc. cit.*
[17] Detlefsen, J. A. 1916. *Amer. Nat.*, 50:46–49.

	vv	Vv	VV
SS	self	slightly pied	not born
Ss	nearly self	pied	not born
ss	pied	black-eyed white (or nearly so)	not born

It seems questionable whether this should be called a dominant white. It cannot, of course, be determined whether the heterozygote Vv is closer to the unknown homozygote VV than to self vv, but it may be pointed out that the ordinary piebald factor would be considered dominant if the homozygote ss were not known, as would also be the case in Dutch rabbits and hooded rats. In man a white blaze is generally considered to be due to a dominant factor, but as no cases have been reported in which homozygotes would be expected to appear, it is not at all unlikely that it is no more dominant than the piebalds in rodents. In any event, the two piebald factors must be classified together. Both of them affect color in general and must be considered as acting on enzyme I of the previous paper. Further they must be considered as doing this through influence on a common developmental factor back of enzyme I. If their modes of influence on enzyme I were wholly independent of each other in development, we would expect one pattern to be simply laid over the other as in white patterns often found in roan Shorthorn cattle, or in the relations of piebald in mice with the white belly of many light-bellied agouti mice. But in the combination ssVv it is the quantity of white, not the pattern, which is combined.

No doubt there are other factors with smaller effects than these two which are inherited independently but coöperate in development. Little[18] describes wild mice with the formula of self SSvv, which yet had a white blaze. The mode of inheritance was irregular although there were distinct indications of segregation.

The dilution of blue mice was demonstrated to be due to a recessive factor by Miss Durham.[19] Little[20] confirmed this result and showed that there is another kind of dilution in mice which produces even more striking effects in yellows and is inherited independently. It seems to follow practically a mode of blending inheritance which has not yet been analyzed as Mendelian. According to Little, factor i reduces black to blue, and red to a peculiar washed-out light red, while the second type of dilution has no appreciable effect on black, but reduces red to a cream in which the hue is different from light red. Factor i evidently belongs in class $1a_3$. It is very different from the dilution of sepia guinea-pigs and has been shown by Miss Durham to be transmitted independently of albinism. The cream type of dilution does not seem to fall into any of the classes given as no provision is made for dilution of yellow without coördinate dilution of black. However, it is characteristic of the dilution of class 1b that much greater effect is produced on yellow than on black. Thus in dilute guinea-pigs (C_dC_d) the yellow parts of the fur are markedly paler than the red of intense ones (CC) yet the black parts are hardly distinguishable. It is only in the lower combinations of the albino allelomorphs in guinea-pigs such as C_dC_a, the heterozygote between dilute and albino, that marked dilution of black becomes apparent. Thus unanalyzed dilution of mice must be placed in class 1b and can be compared with the unanalyzed minor variations in intensity in guinea-pigs which coöperate with the albino series.

Complete albinism of mice was the first Mendelian factor to be demonstrated in mammals. Cuénot's[21] result has been confirmed by all later workers. In rats, guinea-pigs and rabbits variations have been discovered which are intermediate between full color and albinism and in all three it is clear that albinism is the extreme in a dilution series and is wholly independent of the

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[18] Little, C. C. 1914. *Amer. Nat.*, 48: 74–82.
[19] Durham, F. M. 1908. *Loc. cit.*
[20] Little, C. C. 1911. *Sci. N. S.*, 33: 896–897.
[21] Cuénot, L. 1902. *Arch. Zool. Exp. et Gén.*, (3), 10. Notes et revue, p. 27.

so-called partial albinism of piebalds. In mice, no intermediate allelomorphs have been discovered, but it is most probable that it is homologous with albinism in the other rodents and therefore to be placed in class 1b.

VARIATIONS OF YELLOW

When Cuénot[22] discovered that the differences between the various colors could be transmitted by albinos as well as by mice in which the colors were visible he devised the very successful factor hypothesis as an explanation. He did not, however, attempt to force all color differences into pairs of allelomorphs. He found that yellow, gray and black behaved as if due to three variations of the same factor, each one being an allelomorph of either of the others. Later[23] he added light-bellied agouti as a variation between yellow and ticked-bellied agouti or gray. Cuénot[24] also discovered the curious fact that yellows could not be obtained in a homozygous condition, a result confirmed by Miss Durham,[25] Castle, Little[26] and others. Kirkham's[27] recent demonstration of excessive degeneration among embryos from the cross yellow by yellow is a most interesting physical confirmation of a conclusion based on genetic evidence.

It may be noted here that other kinds of yellows may exist among mice. Hagedoorn[28] has announced some very peculiar results including work on dominant and recessive strains of yellow mice both of which could be bred true and, therefore, were different from the yellows of all other investigators. His results, however, need confirmation as they were in many cases inconsistent with his own interpretation.[29]

A white-bellied gray mouse (A_LA_L) differs from a black (A_bA_b) in several respects. Each hair on the back is black at the base and tip with a yellow band between and on the belly each hair may be white throughout. A black mouse has solid black hair all over. Thus the same factor appears to determine a pattern difference between back and belly, a curious cycle in the development of colors on the back and complete or nearly complete inhibition of all color on the belly. Physiologically, however, the case is probably not as complex as at first appears. By crossing with very intensely colored mice the belly may be changed from white to yellow, and black can be brought out at the base of the hairs. It is evident that the belly really differs from the back in having a widening of the yellow band to cover the whole hair and in a dilution of this yellow nearly or entirely to white. Neither of these differences is necessarily determined by the agouti factor, but is merely revealed by the latter. The case is entirely comparable with that of the gray rabbit discussed in the previous paper. No doubt the belly differs from the back even in solid blacks in having a lower density of black and also a lower level of color production in general, only revealed when the agouti factor introduces an inhibitor of black into all parts of the coat. This inhibitor finds less of the black-producing enzyme to inhibit on the belly, and so produces a wider band which, however, appears white instead of yellow because differentiation during development has left the general level of color production on the belly below the threshold for yellow. Thus the four allelomorphs of the agouti series can be interpreted as determining simply four different rates of production of an inhibitor for black.

A series of variations of yellow has

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[22] Cuénot, L. 1903. *Ibid.* (4), 1, Notes et revue, 33–41.
[23] Cuénot, L. 1907. *Loc. cit.*
[24] Cuénot, L. 1905, 1908, 1911. *Loc. cit.*
[25] Durham, F. M. 1911. *Jour. Gen.*, 1:159–178.
[26] Castle, W. E. 1906. *Sci. N. S.*, 24:275–280. (And C. C. Little. 1910. *Sci. N. S.*, 32:868–870.)
[27] Kirkham, W. B. 1916. *Abstracts Amer. Soc. Zool.*, p. 8.
[28] Hagedoorn, A. 1908, 1909. *Univ. Cal. Pub. in Physiol.* 1912. *Zeit. f. Abst. Ver.*, 6:97–136.
[29] See for example, Cuénot, 1911, *loc. cit.*; Plate, 1912, *Zeit. f. Abst. Ver.*, 6; Little, 1914, 48:74–82; Lang, 1914, *Experimentelle Vererbungslehre.*

long been known which does not enter into the linear series just discussed. These are the sooty yellows, sables, and black-and-tans investigated by Miss Durham,[30] Little[31] and Dunn.[32] In the sooty yellows more or less black pigment is mixed with the yellow on the back, while in black-and-tans the entire back is black leaving only the belly yellow. These variations are independent, genetically, of the yellow factor and can be introduced readily into grays, producing gray-bellied blacks, and into blacks, producing very dense blacks. They are spoken of as deepeners of black. The mode of inheritance is irregular and has not been analyzed. Physiologically these factors may be considered as increasing the rate of production of enzyme II, thus increasing the absolute amount of the differentiation between back and belly spoken of above and giving the agouti factors more to inhibit especially on the back. These deepening factors appear to have no effect on the intensity of yellow as the belly in black-and-tans may be any color from red to white. They clearly belong in class $2a_3$.

VARIATIONS OF BLACK

Two Mendelian factors are known which vary the intensity of black without influence on the yellow parts of the coat, but which act in a fundamentally different way from the deepeners of black just dealt with. The latter are in a sense alternative in their affect on pigment. With them a granule is either black or yellow and the intergrade between black and yellow in the fur is sooty yellow. In the brown-eyed brown mice,[33] and the pink-eyed lilacs,[34] on the other hand, the character of the pigment seems to be really intermediate between black and yellow, uniformly throughout skin, coat and eye. The effect is a brown. Again, increase in intensity among the deepening factors has a very direct relation to the effect of the agouti factor and suggests titration of an increase in enzyme II against an inhibitor. The width of the yellow band of agoutis also increases to some extent when black is changed to brown or lilac but not to anything like as marked an extent. Indeed, Dunn has been able to produce brown-and-tans in which brown takes the place of black in black-and-tans. In the first paper it was suggested that such variations as black-and-tan could be pictured as representing variations in the actual quantity of a specific enzyme for the production of dark colors, while in browns and lilacs there is no reduction in the quantity to be titrated against inhibiting agents, but a reduction in potency of some other kind so that pigment is produced intermediate in character between black and yellow Such variations are put in class 2b.

The Marriage Rate of the Insane

The marriage rate of the insane is discussed by Dr. A. Myerson, pathologist of the Taunton State Hospital, in in the January, 1917, issue of the *American Journal of Insanity*. Basing his conclusions on a study of 663 families, he finds that the female insane and the general paretics, both male and female, marry in slightly less proportion than does the general population. Alcoholic males marry in much reduced ratio, while alcoholic females marry in nearly normal ratio. It is to the dementia praecox group that marriage offers the greatest difficulty, for here both the male and female ratios are very low and the former, the male rate, is only about one-half the latter, the female rate. To some extent, then, all types of mental abnormality act as barriers to reproduction, but in the female sex the hindrance is very slight.

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[30] Durham, F. M. 1911. *Loc. cit.*
[31] Little, C. C. 1913. *Carn. Inst. Wash. Pub.*, 179: 11–102. 1916. *Amer. Nat.*, 50: 335–349.
[32] Dunn, L. C. 1916. *Amer. Nat.*, 50: 664–675.
[33] Cuénot, L. 1905, 1907. *Loc. cit.* Durham. 1908. *Loc. cit.*, etc.
[34] Cuénot, L. 1907. *Loc. cit.* Darbishire. 1904. *Loc. cit.* Castle and Little. 1909. *Sci. N. S.*, 30:313–314. Plate, 1910. *Zool. Anz.*, 35:634–640. *Durham*. 1911. *Loc. cit.*, etc.

COLOR INHERITANCE IN SWINE

Heredity Appears to be Mendelian—Some New Facts from Unusual Crosses—Body Stripes Characteristic of the Primitive Wild Boar Have Not Yet Been Eliminated

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MENDEL'S principles of unit characters, dominance and segregation seem manifested in color characters of swine. Smith[1] showed in the case of the Yorkshire crossed with the Berkshire or Poland China that white was dominant over black in the F_1 generation. Secondly, in the F_2 generation, the colors showed "a general tendency for the original parent colors to be expressed separately and in the proportion of three dominants to one recessive." Thirdly, "in nearly all cases the recessive black of the F_2 generation carried more white than the original black parents. This suggests the requirement of a number of germinal factors for each color rather than a single factor." Q. I. and J. P. Simpson[2] in a study of crossing various breeds of swine, state, "The exact application of Mendel's law to all swine hybrids, where the initiative subjects have been proven pure and homozygous in germ, and the similarity of process in all sexual animals and plants in chromosome reduction preparatory to fertilization, leads us to conclude that when pure they will all obey Mendel's laws absolutely; and when marked deviation in the hybridization is found it is proof positive of contamination in one or both subjects."

In the spring of 1915 a litter was farrowed, the result of mating a Berkshire sow, Dora XVIII of Penn State 199,330 with a Duroc Jersey boar, Fancy King 58,875. In this litter of seven pigs, six were red with black spots and one (see Fig. 17) was black with white spots. In the spring of 1917 another litter, the result of mating another pure bred Duroc Jersey boar with a pure bred Berkshire sow, produced five pigs, four of which were red with black spots and one black with the white markings of a Berkshire. The appearance of black and white in the F_1 generation of this cross had never been observed in a similar mating at the Pennsylvania State College. Because of this unusual case of a black and white sow pig in the F_1 generation (1915), she was selected with a sister of the same litter possessing the usual red and black colors to be used for further investigation. In the case of the black and white pig farrowed in 1917, its hereditary color factors have not been investigated.

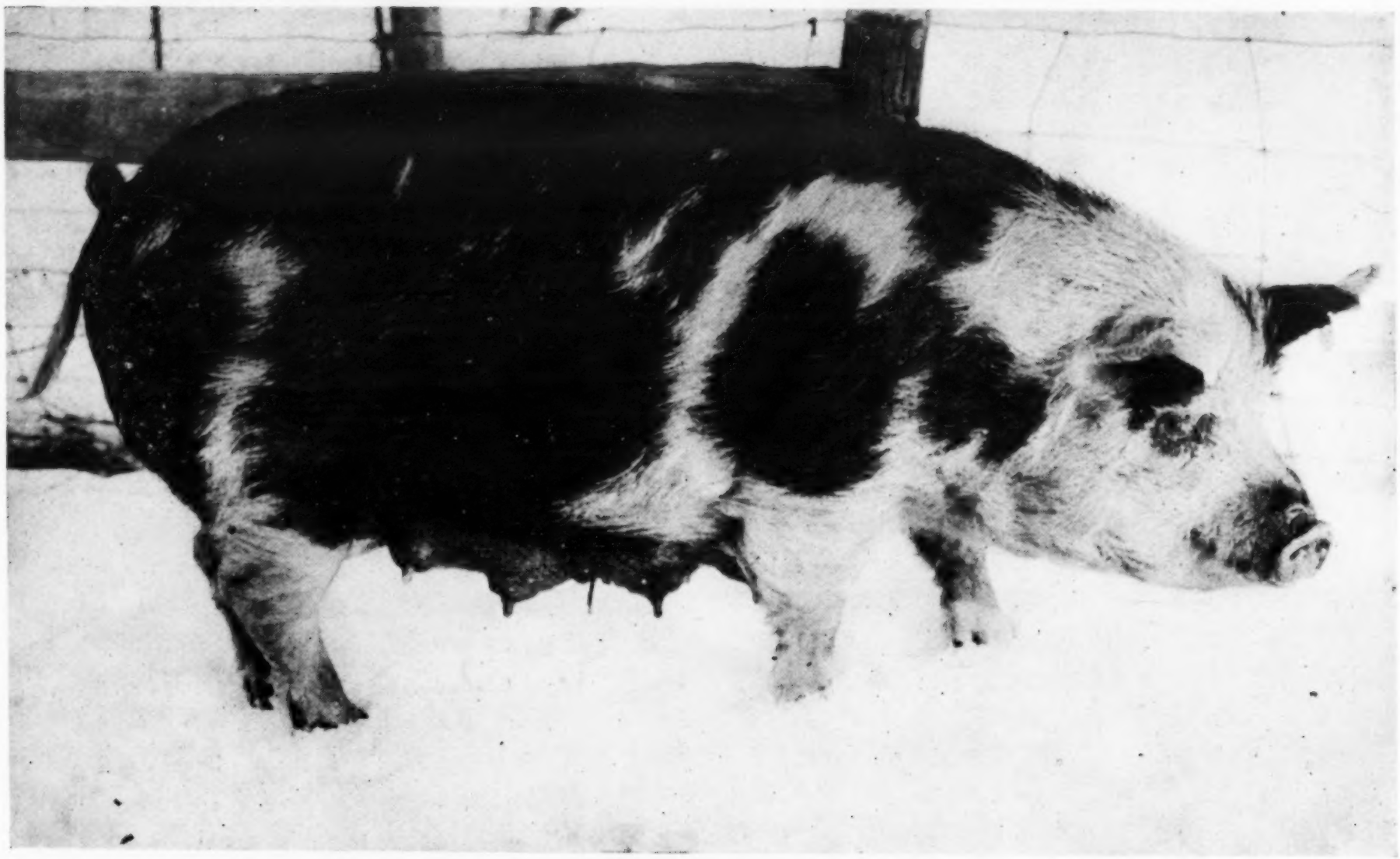
The black and white crossbred sow, born in 1915, was designated No. I and her litter mate was designated No. II. These sows, (F_1 generation) were both mated at one year of age to a pure bred Berkshire boar, Rival's Duke XXII 193,441, the object being to determine whether the black and white sow, No. I, possessed any hereditary factor for red. Sow No. II was used as a check.

RESULTS OF MATING

Breeding		*Color of offspring*			
Boar	*Sow*	*Red and black*	*Black and white*	*Red, white and black*	*Yellow and black*
* Duroc Jersey, 58,875	Berkshire, 199,330	6	1	..	..
† Berkshire, 193,411	Cross Bred No. I	1	5	2	1
† Berkshire, 193,411	Cross Bred No. II	2	4	4	..

* F_1 generation. † F_2 generation.

[1] Color Inheritance in Swine, *American Breeder's Magazine*, Vol. iv, p. 113.
[2] Analytical Hybridization, *Proceedings A. B. A.*, Vol. vii, p. 266.



UNUSUAL RESULT OF A BERKSHIRE X DUROC JERSEY CROSS

Crossbred sow born at Pennsylvania State College in 1915 from mating of Berkshire sow and Duroc Jersey boar. The usual result of this cross is a red pig with black spots, but this animal is black instead of red, with white spots or blotches. While she did not show any red, she carried it in her germ-plasm, for when she was mated to a Berkshire boar she farrowed nine pigs, eight of whom had some red hair. (Fig. 17.)

The litter from the cross-bred sow No. I (black and white) when mated with a Berkshire boar showed greater variation than the table indicates. The white hair on this sow during the late summer of 1915 became yellowish which is usual in white swine, but in the winter appeared pure white. However, at about one year of age a light reddish streak appeared between the ears and extended over the dorsal region of the neck or 4 for 5 inches.

In her litter, the five pigs designated as black and white, only one could be described as being pure black with white spots. The other four possessed sandy-colored hair (reddish tint) about the snout. Only one pig was red and black, and in this case the black predominated over the body with spots of red hair. The predominance of black over red in the F_1 generation has never been observed by the writer in the F_1 generation of a Berkshire Duroc Jersey cross. The usual color marking of the F_1 generation did not appear in the second generation when sow No. 1 was mated to a Berkshire boar. One pig was a bright brownish yellow and piebald black. Two pigs showed the three colors black, red and white distinctly. One of these tri-colored pigs possessed a black body with irregular spots of red and white. The other pig possessed five longitudinal stripes of reddish hair on a black body spotted with white hair. This last case is interesting because the young of the "wild boar" are marked with longitudinal body stripes. This seems to be an exception to the statement made by Castle:[3] "This banded character of both young and adult has apparently been lost in all domestic breeds [swine] which are either self black, red or white or else black or red spotted with white." The only explanation of these longitudinal body stripes seems to be that their hereditary determiners have not been entirely eliminated from improved breeds of swine.

Due to the fact that eight out of the nine pigs in the litter from cross bred sow No. 1 showed red or traces of red

hair, it is evident that this sow carried a germinal factor for the red color. The Berkshire is claimed to possess heredity for red, but in this case there is no apparent ground for believing that sow No. 1 did not possess factors for three colors, black, white and red.

In the case of the cross bred sow No. II a litter of ten pigs resulted from a mating with the same Berkshire boar that sired the litter of cross bred sow No. I. This sow possessed a red body and was spotted black. Like sow No. I, sow No. II changed noticeably in color after one year of age; as she matured the red hair on the belly and face became a pale yellow. The litter from sow No. II was more uniform in color than that from sow No. I. Two pigs were red with black spots, four were black with white spots and four were reddish black with white spots.

Apparently there seems to be a reversion of dominance in color of sows No. I and II. In the case of No. I the black replaces the usual red body color and white replaces the usual black spots of the Berkshire Duroc Jersey cross. In sow No. II, which had the usual red body with black spots, the white hair was either recessive or inhibited by some other factor. In the case of sow No. I the factor for longitudinal body stripes possessed by the wild boar may have inhibited the expression of her red factor. The fact that she did show a light streak of red over the dorsal region of the neck leads to this suspicion.

COLOR IN OTHER CROSSES

My observations with reference to the color shown in the crossing of the various breeds in the F_1 generation are as follows:

1. Berkshire x Tamworth.
   Red (darker than Duroc Jersey) with black spots.
2. Berkshire x Duroc Jersey.
   Red (varying shades) with black spots.
   Black (rare) with white spots.
3. Berkshire x Yorkshire.
   White (solid).
   White with black spots (rare).
4. Yorkshire x Tamworth.
   White (solid) with reddish tint.
5. Yorkshire x Duroc Jersey.
   White (solid) with reddish tint.
6. Berkshire x Chester White.
   White (solid).
   White with spotted black (high proportion).

These observations do not agree with the general opinion and statements that the self white of the Yorkshire is completely dominant over the red of the Tamworth and Duroc Jersey.

A Classical Study of Criminals

Considerable progress is being made on the problem of heredity vs. environment, by exact methods of investigation, J. B. Miner remarks in the May issue of the *Psychologicial Bulletin.* He thinks that Goring's fundamental research in this field is so important that it should be more generally available. This research covered scores of measurements and objective facts about three thousand British convicts. It took about ten years to complete. The conclusions rest upon the most complete treatment of the data under the advice of Karl Pearson of the Biometric Laboratory. It is a classical example of the importance of multiple correlation in resolving complex problems. It first thoroughly refutes the claims of the school of Lombroso as to the existence of a physical criminal type by showing that over thirty suggested physical characteristics are not related to criminality. Goring then demonstrates that criminality runs in families, but mainly through its relation to intellectual deficiency, which shows a correlation of .66 with criminality. Through deficiency it becomes associated with alcoholism, epilepsy and social profligacy. Moreover, numerous external factors, such as example in the home, schooling, size of family, economic and employment conditions, were found to have no significant relation to frequency or length of imprisonment. The correlations indicated that "... relatively to its origin in the constitution of the malefactor, and especially in his mentally defective constitution, crime in this country is only to a trifling extent (if to any) the product of social inequality, or of adverse environment ..."

[3] Castle's "Genetics and Eugenics," p. 137.

THE EXPLANATION OF SELF-STERILITY

E. M. East, *Bussey Institution, Forest Hills, Mass.*

IN A recent paper by C. W. Moore[1] on the subject of self-sterility, several ill-advised statements were made to which attention should be called.

The paper begins with the sentence:

> Several who have made a study of the problem of the inheritance of self-sterility of plants have obtained results which did not point to any one definite manner in which flowers act when self-pollinated.

One might read into the meaning of this statement either that there was great difference of opinion regarding the behavior of self-sterile plants or that little was known regarding self-sterility before the appearance of the paper under discussion. As a matter of fact a great many details regarding self-sterile plants are known. Darwin dealt with the matter at some length, and more recently extended researches by Jost, Correns, Compton and Stout have appeared. The present writer has also investigated the subject rather minutely although only preliminary reports of the work have been published. As to the gross facts, there is not a great difference of opinion among the later writers. Each has found that pollen grains germinate after self-pollination as readily as they do after cross-pollination, but that they grow more slowly, and the present writer has determined that the growth curves of self-pollen tubes are approximately straight lines, while growth curves of cross-pollen tubes are similar to those of autocatalytic reactions. Each has found that there is cross-sterility of the same nature as self-sterility. In other words, the plants of a self-sterile race are not only self-incompatible, but some combinations are cross-incompatible. The differences of opinion come in interpretation of these results, and these differences are due largely, we believe, to the fragmentary character of the evidence.

Moore founds an hypothesis by which to explain self-sterility on the supposed fact that self-tubes are greater in diameter than cross-tubes. In fact this seems to be the main thesis of his paper. He says:

> . . . the greater width of the self-pollinated pollen tubes of Tradescantia is due to the fact that the food supply is more favorable to the nourishment of a self-pollen tube than it is to a cross-pollen tube. On account of the abundant food supply the pollen tubes did not lengthen, but grew wider since they were in a very favorable medium. By this hypothesis it is possible to explain most of the data here presented. . . .

What Moore did was to measure *short* self-pollen tubes and *long* cross-pollen tubes as he distinctly states on page 204. Now if he had measured self-pollen tubes and cross-pollen tubes of the same length, as he should have done, it is almost certain that he would have found them to be of the same width. At least this is the observation of the writer on numerous pistils of three different self-sterile species of Nicotiana. Moore's main thesis, therefore, seems to be based upon an improper observation.

The second point made in the paper, involving a criticism of the present writer, is similarly without foundation He says:

> He [East] states that "all gametes having in their hereditary constitution something different from that of the cells of the mother plant, however, can provoke the proper secretion to stimulate the pollen tube growth, reach the ovary before the flower wilts, and produce seeds." From this it may be inferred that there may be an enzyme in the pollen grain that in a cross-pollination is able to induce the stigma to excrete a stimulating substance so that the pollen tube is able to grow. In a self-pollination this enzyme is not able to act. However, if this were the case, when a few cross-pollen grains were placed on a self-pollinated stigma, they would be expected to germinate and cause the stigma to produce the stimulating substance. Thus the pollen tubes from the self-pollination would also benefit by the stimulating influence and should b

[1] Journal of Heredity, viii, 203–207, 1917.

able to grow and bring about fertilization. However, the work on alsike clover does not support this hypothesis.

This idea of Moore is diametrically opposed to modern conceptions of colloid chemistry. Plant enzymes do not pass freely through cell membranes and diffuse through the tissues. They are very local in their action as is shown very clearly by the definite lines of demarcation between colors in certain corollas. Nevertheless, to be on the safe side the writer made two experiments calculated to test the effect of cross-pollen tubes on self-pollen tubes. In the first experiment five pistils were pollinated with a definite number of cross-pollen grains under a binocular and then covered with self-pollen. Three capsules matured, and yielded seeds as follows:

Pistil No.	*No. cross-pollen grains used*	*No. seeds produced*
1	51	46
2	48	42
3	50	41

Since the experimental error was probably only plus or minus three pollen grains, the indications are clearly that no self-pollen tubes contributed toward the production of these seeds. But, of course, the matter is not proved definitely. A more critical test was the following: Three pistils of a white-flowered plant breeding true for white flowers were selfed. After a few hours compatible pollen from a plant breeding true for red flowers was placed upon these same stigmas. Capsules full of seed were obtained. These seed, if produced only by the action of the pollen from the red flowered plant should produce only red flowered plants since red is dominant. Not all the plants from these seeds have blossomed, but thus far *no white-flowered plants have been produced.*

The main theses defended in Moore's paper, therefore, are both based upon incorrect observations and upon fallacious reasoning.

The Mentality of Orphans

The mentality of orphans and of children who are dependent on public care for other reasons, is low, according to Professor Rudolf Pintner of Ohio State University, in the *Journal of Educational Psychology* (April, 1917). Stenquist, Thorndike and Trabue, testing dependent children in New York, found that in general they fell below public school children of the same age, in intelligence. Hall secured similar results in New York state orphan asylums. Streeter, testing the children in the orphanages of New Hampshire, found 49% normal, 30% backward and 21% feebleminded. Pintner tested 82 children for the Ohio State Board of Charities and found that only 37% were normal, 19% being feebleminded and the rest backward. A test which he made of 106 children in a county children's home showed 7% who were bright, 35% normal, 11% feebleminded, and the remainder backward.

Disabled Soldiers Marry in England

As soldiers who were disabled at the front are likely to be of superior eugenic quality, it is important to their nation that their disabilities should not prevent them from leaving descendants. The English *Eugenics Review*, which has interested itself in this problem, publishes some interesting facts in its last issue. Of 440 blinded soldiers entering St. Dunstan's Hostel, 144 were previously married and 296, or rather more than two-thirds, were single. Of these single men 55, or 18%, have married since their disablement. It is noted that the wives are to be considered in every case as extremely suitable, and almost without exception as unusually good looking. It is evident, therefore, that the idea suggested recently in England of finding wives for blinded soldiers among those girls who are physically so unattractive as otherwise to be destined to celibacy, is not being carried out.

POLLINATING THE PECAN

Systematic breeding, requiring careful cross-pollination, is of much importance to the pecan grower. The photograph below shows the method which we now find most satisfactory for protecting pollinated blossoms. When the pollen is ripe on thousands of trees at the same time, the air is full of it; and it's the same way with thrips—there are millions of them wherever one turns. Formerly we protected our pollinated blossoms with paper bags large enough to envelop all the leaves, but this did not always keep out foreign pollen and thrips, and it frequently damaged the leaves, which had a corresponding effect on the nuts. We have learned that sound leaves are absolutely necessary from start to finish, for a perfect fruit. The method shown in Fig. 18 is not only secure, but lets the leaves have full benefit of the air and light. So important is the latter, in our experience, that we do all our breeding work on the south side of the trees, where the maximum of sunlight falls. In pollinating, I may add that it is my practice first to breathe on the pistillate blossoms—this seems to make the pollen stick better.

E. E. RISIEN, San Saba, Tex.

PROTECTING POLLINATED PECAN BLOSSOMS

In the lower central part of the photograph is a heavy bunch of catkins (male blossoms): these the operator always strips off. Directly above these is a small square of white paper, on which are some pistillate (female) flowers in a condition to be cross-pollinated. At the left is a cluster of pistillate blossoms protected by being wrapped in cotton batting; opposite this at the right is a similar cluster, the cotton being enveloped with a piece of heavy glacine paper, as a protection from moisture. (Fig. 18.)

Genetics Literature

THE annual reports of the AMERICAN BREEDERS' ASSOCIATION, published in seven volumes, form the most valuable collection of material for students of genetics which has been published in the United States. Most of them are out of print and are becoming expensive. All of them are nearly indispensable to libraries, institutions and students of plant and animal breeding, heredity, variation, eugenics, or genetics in general.

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